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**FURTHER NOTES ON THE GENUS LITOTETOTHRIPS  
(THYSANOPTERA : PHLAEOTHIRIPIDAE)**

By IWAO KUDÔ

Systematic and Ecological Surveys on Some Plant-Parasitic Microarthropods  
in Southeast Asia, Scientific Report No. 20.

*Abstract*

KUDÔ, I. 1994. Further notes on the genus *Litotetothrips* (Thysanoptera : Phlaeothripidae). *Ins. matsum. n. s.* 50 : 53-78, 6 tabs., 10 figs.

Five new species of *Litotetothrips* are described from Semenanjung Malaysia : *L. berangan* on *Castanopsis schefferiana*, *L. kochummeni* on *Castanopsis* sp., *L. keladan* on *Dryobalanops oblongifolia*, *L. pinanganus* on *Engelhardtia spicata*, and *L. medangteja* on *Cinnamomum iners*. The second instar larvae of five species, *L. medangteja*, *L. pasaniae*, *L. pinanganus*, *L. roberti* and *L. rotundus*, are described for the first time. A key to the known species of *Litotetothrips* is presented.

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*Contents.* Introduction — *Litotetothrips keladan* — *L. kochummeni* — *L. berangan* — *L. pinanganus* — *L. medangteja* — *L. rotundus* — *L. pasaniae* — *L. roberti* — Key to the species — References.

## INTRODUCTION

The genus *Litotethrips* is a small group of medium-sized thrips living on tree leaves in eastern Asia including Japan, Taiwan and Malaysia. It has been known by four species, each feeding on one or two plant species belonging to Fagaceae, Lauraceae or Dipterocarpaceae: *L. pasaniae* on *Castanopsis cuspidata* in Japan and Taiwan, *L. roberti* on *Quercus serrata* in Japan, *L. rotundus* on *Cinnamomum japonicum* and *C. camphora* in Japan, Taiwan and Hongkong, and *L. shoreae* on *Shorea leprosula* and *S. acuminata* in Malaysia (Kudô 1975, Mound 1983). Five new species described below also appear to be monophagous, their host plants belonging to the three families mentioned above and Juglandaceae. The occurrence of *L. shoreae* causes blackish green or brown blotches on the leaves (Mound op. cit.), but this is not the case with the other species of the genus, which are associated with mature rather than young leaves. *Litotethrips* probably originated in the tropical rain forest and later expanded to warm temperate forests, because it has now six species occurring in Semenanjung Malaysia.

*Litotethrips* is characterized by the combination of the following characters: elongate and slender seventh and eighth antennal segments; one sense cone on the third antennal segment and two or three on the fourth; head broad but constricted basally; small prothoracic anteroangular and anteromarginal setae; incomplete pronotopleural suture; absence of the prothoracic basisternum and metasternopleural suture; mesopresternum occasionally rudimentary; and three subbasal setae on the fore wing usually small, one or two of them occasionally disappearing. The males of some species are unusual in the posteromarginal or "major" setae on the ninth abdominal segment: *L. shoreae* has short and thin setae  $B_1$ , *L. berangan* has long  $B_2$  but shows short and thin  $B_3$ , and *L. kochummeni* and *L. pasaniae* have short and thin  $B_3$ .

The known species of *Litotethrips* are easily distinguished from one another by some structural characters, color patterns on the legs, and their host plants, without the use of metric characters. However, all the specimens examined were measured for some body parts to find useful characters in tubuliferan taxonomy. Some ratios and measurements in four species, based on reasonably large numbers of females, are given in Table 1 to 6 (in which the observed range, mean  $\pm$  standard deviation, and the number of specimens examined are given in the mentioned order). Almost all of them considerably overlap among species. Nevertheless, it is worth mentioning that the numbers of setae on the third to sixth antennal segments show specific and sexual differences in most species.

Also in the second instar larvae the species are easily identified by brown patches on the pteronotum and eighth abdominal tergum and setae on the sixth to ninth abdominal terga as well as by their host plants. This instar is characterized as follows: head brown, wider than long; cephalic seta  $B_3$  minute, occasionally disappearing; brown pronotal plates present; ninth to 11th abdominal segments brown; seta  $B_3$  on ninth tergum minute; most dorsal setae on body blunt or expanded apically, arising from a brown patch.

This is a second paper based on thrips collected under the project "Systematic and ecological surveys on some plant-parasitic microarthropods in Southeast Asia." About half of the specimens examined, including the holotypes of the new species,

will be deposited in Seksyen Entomologi, Institut Penyelidikan Perhutanan Malaysia (=Entomology Section, Forest Research Institute of Malaysia [FRIM]), Kepong, Selangor, Malaysia. The host plants were identified by Mr. K.M. Kochummen, ex-Botanist at FRIM.

Before going further, I would like to express my hearty gratitude to the late Dr. Tho Yow Pong (FRIM), Dr. Khoo Soo Ghee (University of Malaysia), Mr. K.M. Kochummen (FRIM), Mr. Azmi Mahyudin (FRIM), Dr. T. Kumata (Hokkaidô University) and Dr. S. Takagi (Hokkaidô University), for their helps in various ways during my surveys in Malaysia. Particular thanks are due to Prof. S. Takagi for his critical reading through the manuscript.

#### DESCRIPTIONS AND RECORDS

Abbreviations.  $A_n$ : Antennal segment n. AAS: Prothoracic anteroangular setae. AMS: Prothoracic anteromarginal setae.  $B_n$ : Setae on body segments numbered in meso-lateral order (see Fig. 5.1 for larva) unless otherwise indicated. EPS: Prothoracic epimeral setae. FH: Fringe hairs on wings. HOW: Hind ocellar width. IOD: Interocellar distance, or distance between hind ocelli. L: Length. MLS: Prothoracic midlateral setae. OOD: Ocelloccipital distance, or distance between posterior margin of hind ocellus and posterior margin of head. PAS: Prothoracic posteroangular setae. POS: Postocular setae.  $S_n$ : Abdominal sternum n.  $T_n$ : Abdominal tergum n. W: Width.

#### *Litotetothrips keladan* n. sp.

Female. Brown; coxae and femora brown, tibiae and tarsi yellow. Wings pale gray.  $A_1$  and  $A_2$  dark brown,  $A_2$  paler apically;  $A_3$ - $A_7$  yellow,  $A_5$ - $A_7$  slightly brownish apically;  $A_8$  pale brown.

Head (Fig. 1.1) sculptured with transversely anastomosing striae, 1.40-1.52 as long as pronotum; W/L 1.11-1.19; POS pointed apically, 0.29-0.32 as long as OOD; IOD/HOW 2.57-2.83; OOD/IOD 3.06-3.28; OOD/pronotum L 1.18-1.24; maxillary stylet reaching eye; maxillary bridge well represented. Antenna (Fig. 1.2):  $A_4$  with 2 major sense cones and no minor cone;  $A_5$ - $A_7$  with 6, 4-5 (mostly 5), 6, 5-6 (usually 6), and 6 primary setae respectively;  $A_3$  with primary setae only;  $A_3$ - $A_8$  L/W 1.89-1.95, 1.41-1.45, 1.58-1.66, 1.78-1.89, 2.43-2.71 and 4.89-5.50 respectively;  $A_6$ L/ $A_3$ L 0.94-1.00;  $A_8$ L/ $A_7$ L 1.21-1.32.

Pronotum (Fig. 1.1) sculptured with transversely anastomosing striae on anterior and posterior thirds; with 18-22 setae in all; MLS and EPS expanded apically; MLS 0.28-0.39, PAS 0.65-0.70 and EPS 0.27-0.44 as long as pronotum respectively. Metanotum (Fig. 1.3) reticulate medially; AMSD (distance between anterior margin and median setae)/MSD (distance between median setae) 2.14-2.60; mesopresternum rudimentary. Metanepimeron with 5 setae, mesosternum with 8-10, metasternum with 16-20. Fore wing with 56-63 FH; without duplicate FH; subbasal  $B_1$  usually and  $B_3$  occasionally absent. Hind wing with 57-62 FH.

Pelta (Fig. 1.4) entirely sculptured on median lobe, with narrow lateral lobes, these occasionally reduced, without campaniform sensilla; tergal lateral setae expanded.  $T_{10}$  L/OOD 0.67-0.71;  $B_1$ - $B_3$  on  $T_9$  pointed apically,  $B_1$  1.76-2.10,  $B_2$

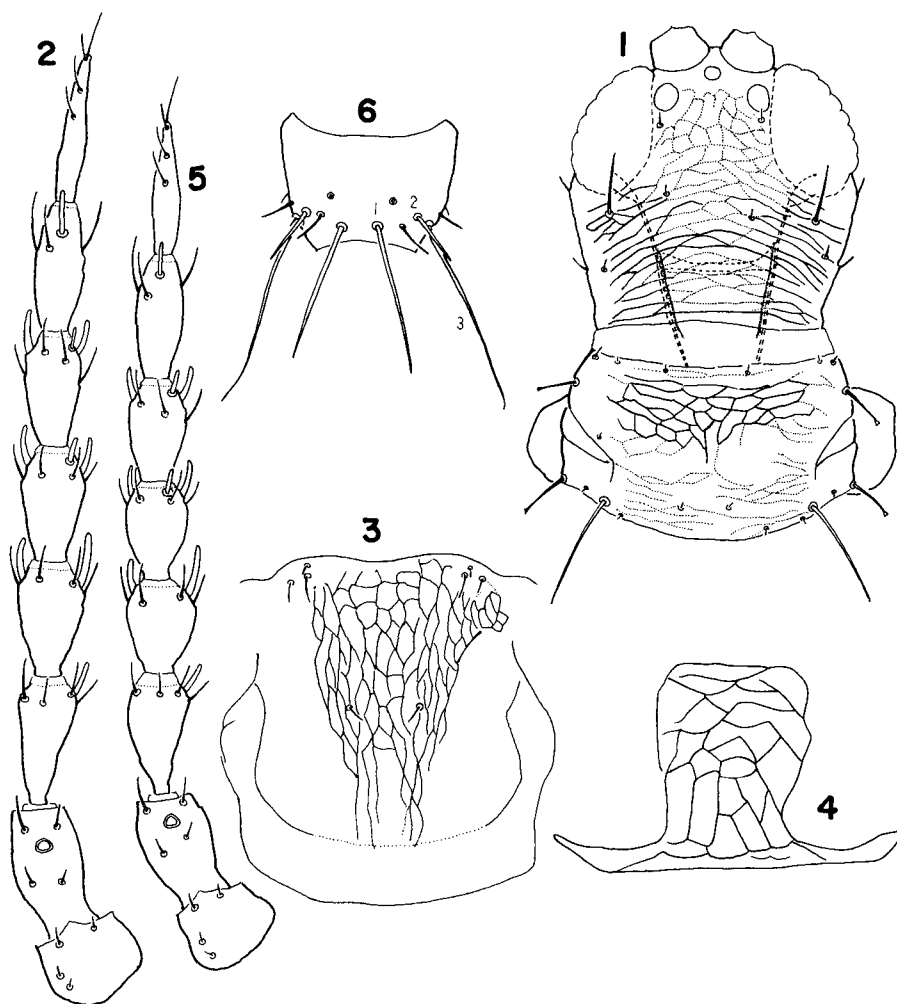


Fig. 1. *Litotetothrips keladan*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, right antenna. 6. ♂,  $T_9$ .

2.10-2.50 and  $B_3$  about 0.5 as long as  $T_9$  respectively.  $S_5$  with 2-4 discal setae.

Measurements ( $\mu\text{m}$ ). Body L 1.1-1.2 mm. Head L 126-140, W 149-165; POS 30-38; OOD 105-118. Pronotum L 86-100, W 152-176; AAS 6, AMS 4, MLS 25-39, PAS 56-69, EPS 24-44. Fore wing subbasal seta  $B_2$  9-14,  $B_3$  4-8.  $T_5$  lateral seta 42-56;  $T_9$  L40-42;  $T_{10}$  L 74-82;  $B_1$  on  $T_9$  74-84,  $B_2$  84-100,  $B_3$  20. L(W) of antennal segments:  $A_3$  36-40 (19-21);  $A_4$  30-32 (21-22);  $A_5$  30-34 (19-21);  $A_6$  32-36 (18-19);  $A_7$  34-38 (14);  $A_8$  44-49 (8-9).

Male. Colored as in female. Head W/L 1.15-1.18, 1.40-1.50 as long as pronotum; IOD/HOW 2.50-3.00; OOD/IOD 2.94-3.13; POS/OOD 0.31-0.34. Antenna (Fig. 1.5):  $A_3$ - $A_7$  with 5-6 (usually 6), 5-6 (mostly 6), 6-7 (mostly 7), 7 and 5-6 (mostly 6) setae respectively;  $A_3$ - $A_8$  L/W 1.74-1.89, 1.17-1.43, 1.25-1.50, 1.42-1.

67, 1.93-2.43 and 4.33-5.13 respectively;  $A_6L/A_3L$  0.79-0.88;  $A_8L/A_7L$  1.15-1.32. Pronotum with 18-23 setae; MLS 0.28-0.37, PAS 0.63-0.69 and EPS 0.28-0.36 as long as pronotum respectively. Metanepimeron with 5 setae, mesosternum with 8, metasternum 18-23; AMSD/MSD 1.92-2.70. Fore wing with 58-65 FH, hind wing with 57-62 FH.  $T_{10}L/OOD$  0.68-0.78;  $B_1$  on  $T_9$  (Fig. 1.6) 1.45-1.77  $B_2$  0.55-0.64 and  $B_3$  1.91-2.05 as long as  $T_9$  respectively.  $S_5$  with 2-3 discal setae.

Measurements ( $\mu m$ ). Body L 1.0-1.1 mm. Head L 120-128, W 140-147; OOD 96-106; POS 30-36. Pronotum L 80-86; MLS 24-31, PAS 54-56, EPS 24-31. Fore wing subbasal seta  $B_2$  8-10,  $B_3$  5-8.  $T_5$  lateral seta 38-42;  $T_9$  L 44,  $T_{10}L$  68-78;  $B_1$  on  $T_9$  64-78,  $B_2$  24-28,  $B_3$  84-90. L (W) of antennal segments:  $A_3$  33-34 (18-20);  $A_4$  24-30 (20-21);  $A_5$  25-27 (18-20);  $A_6$  27-30 (17-19);  $A_7$  28-34 (14-15);  $A_8$  37-41 (8-9).

Specimens examined. Semenanjung Malaysia — Selangor: Kuala Lumpur: Kepong, holotype ( $\varphi$ ) & 3 $\varphi$  4 $\sigma$  (*Dryobalanops oblongifolia*, Dipterocarpaceae, Malaysian name: keladan), X. 31. 1991.

Remarks. This is the smallest species of the genus, and a second species living on Dipterocarpaceae. In the male the antennal segments are thicker than in the female as in *L. kochummeni* and *L. berangan*. It is unique in having short posteromarginal setae  $B_3$  on  $T_9$  in the female. *L. keladan* may come near *L. kochummeni* but it is distinguished by the rudimentary mesopresternum, by  $A_3$  with primary setae only, by MLS, EPS and tergal lateral setae expanded, and by the maxillary bridge well represented.

*Litotetothrips kochummeni* n. sp.

Female. Brown; coxae and femora brown; tibiae and tarsi yellow. Wings pale.  $A_1$  and  $A_2$  dark brown,  $A_2$  paler apically;  $A_3$ - $A_7$  yellow;  $A_8$  yellow basally, pale brown apically.

Head (Fig. 2.1) sculptured with transversely anastomosing striae, 1.34-1.54 as long as pronotum; W/L 1.16-1.21; POS pointed apically, 0.27-0.41 as long as OOD; IOD/HOW 2.22-2.63; OOD/IOD 2.82-3.20; OOD/pronotum L 1.14-1.28; maxillary stylet reaching POS; maxillary bridge so weakly present that it can be scarcely seen. Antenna (Fig. 2.2):  $A_4$  with 2 major sense cones and 1 minor cone;  $A_3$ - $A_7$  with 6, 5, 5-7 (usually 6), 5-6 (usually 6), and 5-6 (mostly 6) primary setae respectively;  $A_8$  with 1-2 (rarely 0) dorsal and 1-2 ventral setae along with primary setae;  $A_3$ - $A_8$  L/W 1.58-1.95, 1.44-1.62, 1.67-1.90, 1.76-2.00, 2.35-2.63 and 4.40-4.90 respectively;  $A_6L/A_3L$  0.88-0.97;  $A_8L/A_7L$  1.10-1.17.

Pronotum (Fig. 2.1) sculptured with transversely anastomosing striae on anterior third and posterior fourth; with 19-20 setae; MLS pointed or blunt apically, EPS blunt or expanded; MLS 0.34-0.40, PAS 0.62-0.69 and EPS 0.45-0.56 as long as pronotum respectively. Metanotum (Fig. 2.3) weakly reticulate; AMSD/MSD 1.00-1.67; mesopresternum well represented. Metanepimeron with 6-7 setae, mesosternum with 12-15, metasternum with 20-22. Fore wing with 72-82 FH, without duplicate FH; subbasal  $B_1$  usually absent. Hind wing with 71-81 FH.

Pelta (Fig. 2.4) irregularly reticulate, without campaniform sensilla; tergal lateral setae pointed or blunt except on  $T_8$  expanded.  $T_{10}L/OOD$  0.95-1.14;  $B_1$  on  $T_9$  1.93-2.19,  $B_2$  2.19-2.47 and  $B_3$  1.4-1.6 as long as  $T_9$  respectively.  $S_5$  with 4-7 discal setae.

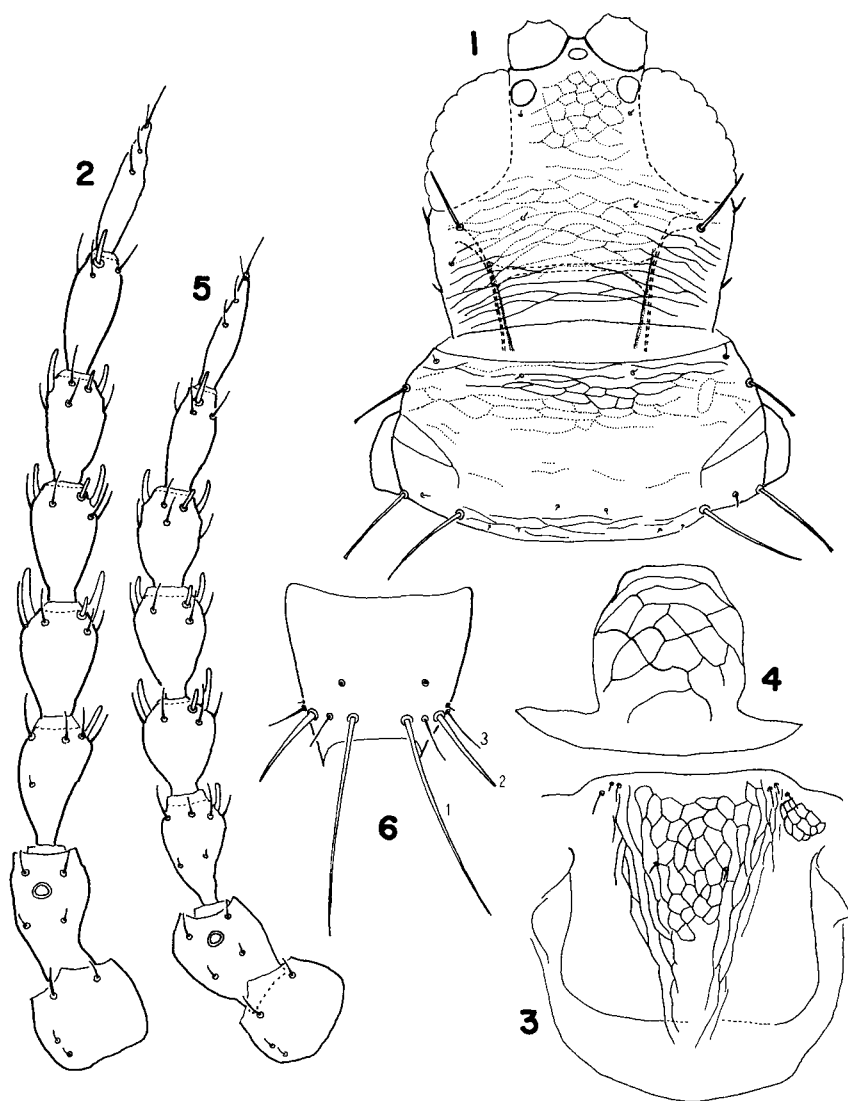


Fig. 2. *Litotetothrips kochummeni*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, right antenna. 6. ♂, T<sub>9</sub>.

Measurements ( $\mu\text{m}$ ). Body L 1.3-1.4 mm. Head L 145-155, W 176-188; OOD 122-132; POS 34-50. Pronotum L 100-116; MLS 38-42, PAS 64-76, EPS 50-56. Fore wing subbasal B<sub>2</sub> 18-26, B<sub>3</sub> 13-20. T<sub>5</sub> lateral seta 55-70; T<sub>9</sub> L 58-64, T<sub>10</sub> L 122-146; B<sub>1</sub> on T<sub>9</sub> 114-140, B<sub>2</sub> 134-148, B<sub>3</sub> 85-105. L (W) of antennal segments: A<sub>3</sub> 38-44 (22-24); A<sub>4</sub> 36-42 (25-26); A<sub>5</sub> 38-42 (21-24); A<sub>6</sub> 37-42 (19-22); A<sub>7</sub> 40-42 (16-17); A<sub>8</sub> 44-49 (10).

Male. Colored as in female. Head W/L 1.15-1.25; IOD/HOW 2.93-3.50; OOD/IOD 2.68; POS/OOD 0.33-0.36. Antenna (Fig. 2.5): A<sub>3</sub>-A<sub>7</sub> with 6, 5-6 (usually

6), 7, 6, and 5-6 (usually 6) primary setae respectively;  $A_6L/A_3L$  0.82-0.94;  $A_8L/A_7L$  1.15-1.25;  $A_3-A_8 L/W$  1.31-1.55, 1.20-1.33, 1.45-1.55, 1.40-1.60, 2.00-2.27 and 3.80-4.00 respectively. Pronotum with 18-20 setae; MLS 0.31-0.38, PAS 0.60-0.64 and EPS 0.47-0.51 as long as pronotum respectively. Metanepimeron with 5-6 setae, mesosternum with 16, metasternum with 24; AMSD/MSD 1.13-1.77. Fore wing with 68-72 FH, hind wing with 69-72 FH.  $T_{10}L/OOD$  1.02-1.11;  $B_2$  on  $T_9$  (Fig. 2.6) short and thick,  $B_3$  very short and thin,  $B_1$  1.62-1.82,  $B_2$  0.64-0.68 and  $B_3$  0.34-0.36 as long as  $T_9$  respectively.  $S_5$  with 5-6 discal setae.

Measurements ( $\mu m$ ). Body L 1.3 mm. Head L 128-136, W 156-160; OOD 110-112; POS 36-40. Pronotum L 102-106; MLS 32-40, PAS 61-68, EPS 50-52. Fore wing subbasal  $B_1$  4-10,  $B_2$  12-20,  $B_3$  12-16.  $T_5$  lateral seta 60;  $T_9$  L 66-74;  $T_{10}$  L 112-124;  $B_1$  on  $T_9$  120,  $B_2$  42-50,  $B_3$  24-25. L (W) of antennal segments:  $A_3$  34 (22-26);  $A_4$  30-32 (24-26);  $A_5$  32-34 (22);  $A_6$  28-32 (20);  $A_7$  32-34 (15-16);  $A_8$  38-40 (10).

Specimens examined. Semenanjung Malaysia — Kedah: Jitra: Bukit Wang, holotype (♀) & 5 ♀ 2 ♂ (*Castanopsis* sp., Fagaceae), XI. 12. 1991.

Remarks. This species has some small setae along with primary setae on  $A_3$  as in *L. berangan*, *L. pasaniae*, *L. pinanganus* and *L. medangleja*. The female has an unusually long 10th abdominal segment, i.e.  $T_{10}$  is 2.1-2.4 as long as  $T_9$  against 1.5-2.1 in the congeners. In the male the posteromarginal setae  $B_3$  on  $T_9$  are shortest among the three pairs as in *L. berangan* and *L. pasaniae*. *L. kochummeni* is distinguished from *L. berangan* by thick  $A_3$  (L/W 1.6-2.0 in female, 1.3-1.6 in male) and by two major sense cones on  $A_4$ .

#### *Litotetothrips berangan* n. sp.

Female. Brown; coxae and femora brown; tibiae and tarsi yellow. Wings pale, slightly brownish at extreme base.  $A_1$  and  $A_2$  dark brown;  $A_3-A_7$  yellow,  $A_7$  brownish apically;  $A_8$  pale brown, yellowish basally.

Head (Fig. 3.1) sculptured with transversely anastomosing striae on posterior half, nearly smooth between eyes; 1.28-1.43 as long as pronotum; W/L 1.09-1.23; IOD/HOW 2.50-3.00; OOD/IOD 2.86-3.25; OOD/pronotum L 1.09-1.16; POS pointed apically, 0.37-0.43 as long as OOD; maxillary stylet reaching POS; maxillary bridge weak, scarcely seen. Antenna (Fig. 3.2):  $A_4$  with 3 major sense cones and 1 minor cone;  $A_3-A_7$  with 5-6 ( $5.7 \pm 0.5$ ,  $n=18$ ), 4-6 ( $5.0 \pm 0.3$ ), 6-7 ( $6.1 \pm 0.2$ ), 5-6 ( $5.7 \pm 0.5$ ), and 6 primary setae respectively;  $A_3$  with 1-2 dorsal and 1-2 ventral setae along with primary setae;  $A_3-A_8 L/W$  2.00-2.27, 1.54-1.83, 1.64-1.76, 1.73-1.90, 2.38-2.79 and 4.50-6.00 respectively;  $A_6L/A_3L$  0.72-0.83;  $A_8L/A_7L$  1.14-1.32.

Pronotum (Fig. 3.1) weakly sculptured with transversely anastomosing striae on anterior and posterior thirds; with 20-25 setae; MLS and EPS blunt apically; MLS 0.28-0.33, PAS 0.57-0.67 and EPS 0.37-0.43 as long as pronotum respectively. Metanotum (Fig. 3.3) weakly reticulate on anteromedian two-thirds; AMSD/MSD 1.69-2.30; mesopresternum well represented. Metanepimeron with 5-8 setae, mesosternum with 11-14, metasternum with 20-23. Fore wing with 71-81 FH; without duplicate FH; subbasal setae  $B_2$  and  $B_3$  usually subequal in length. Hind wing with 68-77 FH.

Pelta (Fig. 3.4) irregularly sculptured on median lobe, without campaniform sensilla; tergal lateral setae pointed or blunt apically.  $T_{10}L/OOD$  0.89-1.00;  $B_1$  on



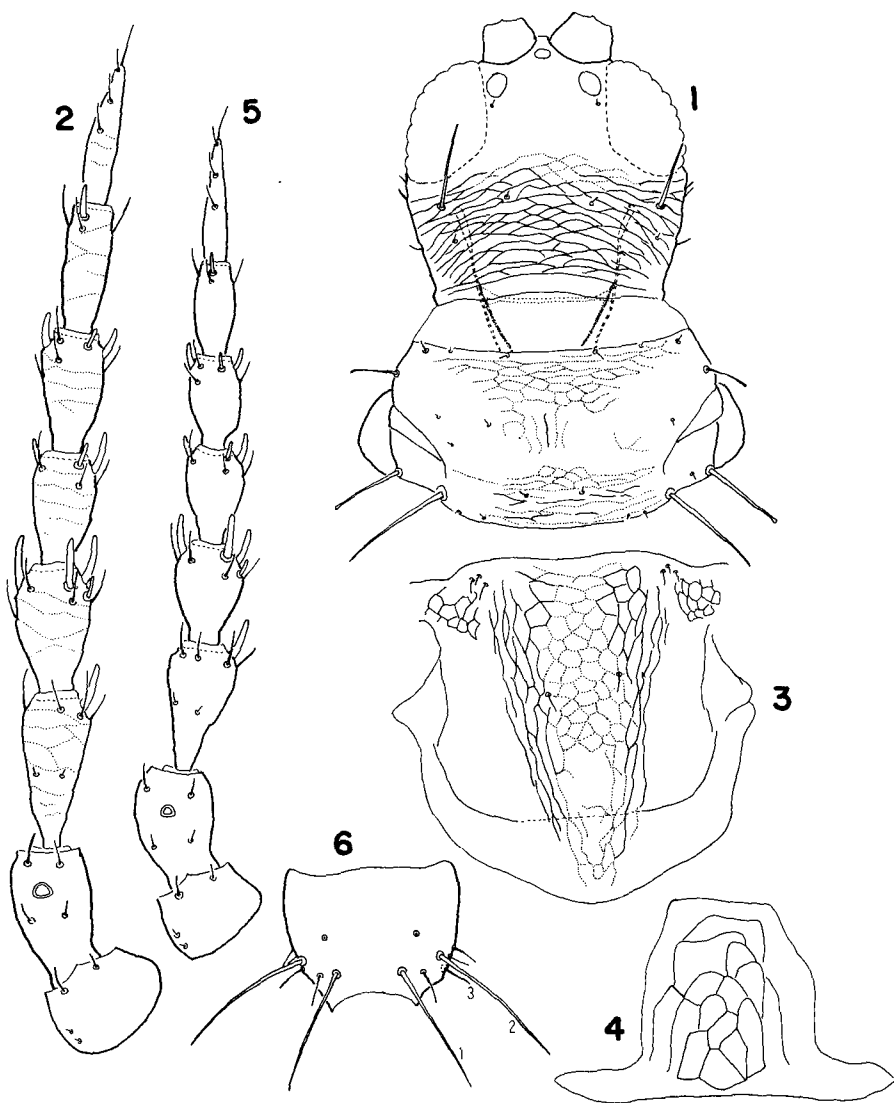


Fig. 3. *Litotetothrips berangan*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, right antenna. 6. ♂,  $T_9$ .

$T_9$  1.47-1.81,  $B_2$  1.85-2.10 and  $B_3$  1.2-1.4 as long as  $T_9$  respectively.  $S_5$  with 4-7 discal setae.

Measurements ( $\mu\text{m}$ ). Body L 1.4-1.6 mm. Head L 148-160, W 168-184; OOD 122-130; POS 46-56. Pronotum L 106-116; AAS 6-12, AMS 5-10, MLS 34-38, PAS 66-76, EPS 41-46. Fore wing subbasal  $B_1$  6-18,  $B_2$  14-25,  $B_3$  14-28.  $T_5$  lateral seta 52-66;  $T_9$ L 62-68;  $T_{10}$  L 112-130;  $B_1$  on  $T_9$  94-114,  $B_2$  120-130,  $B_3$  76-84. L (W) of antennal segments:  $A_3$  44-50 (21-23);  $A_4$  40-46 (24-26);  $A_5$  36-38 (21-22);  $A_6$  36-38 (19-22);  $A_7$  36-42 (14-16);  $A_8$  45-50 (8-10).

Male. Colored as in female. Head W/L 1.14-1.26; IOD/HOW 2.86; OOD/IOD 2.65-2.80; POS/OOD 0.36-0.38. Antenna (Fig. 3.5):  $A_3$ - $A_7$  with 6, 6, 5-7 (usually 6), 5-6 (usually 6), and 6-7 (usually 6) primary setae respectively;  $A_3$ - $A_8$  L/W 1.82-2.00, 1.29-1.39, 1.40-1.50, 1.56-1.61, 1.87-2.27 and 3.89-4.44 respectively;  $A_6$ L/ $A_3$  L 0.68-0.75;  $A_8$ L/ $A_7$ L 1.18-1.27. Pronotum with 21-25 setae; MLS 0.27-0.33, PAS 0.53-0.59 and EPS 0.41-0.43 as long as pronotum respectively. Metanepimeron with 7-9 setae, mesosternum with 11-14, metasternum with 18-23; AMSD/MSD 1.60-2.40. Fore wing with 68-71 FH, hind wing with 64-69 FH.  $T_{10}$ L/OOD 0.89-0.96;  $B_2$  on  $T_9$  (Fig. 3.6) longer than  $B_1$ ,  $B_3$  short and thin,  $B_1$  1.05-1.13,  $B_2$  1.19-1.30 and  $B_3$  0.26-0.28 as long as  $T_9$  respectively.  $S_5$  with 3-4 discal setae.

Measurements ( $\mu$ m). Body L 1.2-1.3 mm. Head L 122-135, W 150-159; OOD 106-112; POS 40. Pronotum L 94-102; MLS 26-32, PAS 54-56, EPS 40-42. Fore wing subbasal  $B_1$  10-14,  $B_2$  8-18,  $B_3$  2-20.  $T_5$  lateral seta 46-56;  $T_9$  L 80-84;  $T_{10}$  L 98-106;  $B_1$  on  $T_9$  88-90,  $B_2$  100-104,  $B_3$  22. L (W) of antennal segments:  $A_3$  40-42 (21-22);  $A_4$  31-33 (23-24);  $A_5$  28-30 (20);  $A_6$  28-30 (18-19);  $A_7$  28-34 (15);  $A_8$  35-40 (9).

Specimens examined. Semenanjung Malaysia — Selangor: Kuala Lumpur: Sungei Buloh, holotype ( $\varphi$ ) & 8  $\varphi$  4  $\sigma$  (*Castanopsis schefferiana*, Fagaceae, Malaysian name: berangan), VIII. 25. 1990.

Remarks. This species is unique in having long, thin posteromarginal setae  $B_2$  on  $T_9$  in the male. *L. berangan* is distinguished from *L. pasaniae* by the mid and hind tibiae yellow and by the slenderer  $A_3$  (L/W 2.0-2.3) in the female.

*Litotetothrips pinanganus* n. sp.

Female. Dark brown. Coxae, femora, and mid and hind tibiae dark brown; fore tibia and all tarsi yellow. Fore wing slightly shaded, brown basally.  $A_1$  and  $A_2$  dark brown,  $A_2$  yellowish apically;  $A_3$ - $A_7$  yellow;  $A_8$  brown, yellowish at extreme base.

Head (Fig. 4.1) nearly smooth, 1.32-1.40 as long as pronotum; W/L 1.04-1.05; IOD/HOW 1.67-1.83; OOD/IOD 4.36-4.70; OOD/pronotum L 1.12-1.20; POS pointed apically, 0.31-0.36 as long as OOD; maxillary stylet not reaching POS; maxillary bridge weak, scarcely seen. Antenna (Fig. 4.2):  $A_4$  with 3 major sense cones and 1 minor cone;  $A_3$ - $A_7$  with 6, 5, 6, 5-6 (usually 6), and 5-6 (usually 6) primary setae respectively;  $A_3$  with 1-2 dorsal setae and 1 ventral seta along with primary setae;  $A_3$ - $A_8$  L/W 2.19-2.27, 1.71-1.76, 2.00-2.14, 2.12-2.31, 2.76-3.05 and 5.00-5.38 respectively;  $A_6$ L/ $A_3$ L 0.81-0.86;  $A_8$ L/ $A_7$ L 1.15-1.21.

Pronotum (Fig. 4.1) smooth, with 24 setae; MLS blunt apically, EPS expanded; MLS 0.40-0.44, PAS 0.66-0.69 and EPS 0.50-0.53 as long as pronotum respectively. Metanotum (Fig. 4.3) smooth medially, sculptured sublaterally with longitudinal striae; AMSD/MSD 1.59-2.17; mesopresternum well represented. Metanepimeron with 6-9 setae, mesosternum with 17-20, metasternum with 25-31. Fore wing with 126-136 FH and 7-10 duplicate FH. Hind wing with 121-136 FH.

Pelta (Fig. 4.4) weakly sculptured on median lobe, without campaniform sensilla; tergal lateral setae blunt or expanded apically.  $T_{10}$ L/OOD 0.94-0.98;  $B_1$  on  $T_9$  1.74-1.80,  $B_2$  1.63-1.67 and  $B_3$  1.3-1.4 as long as  $T_9$  respectively.  $S_5$  with 10-11 discal setae.

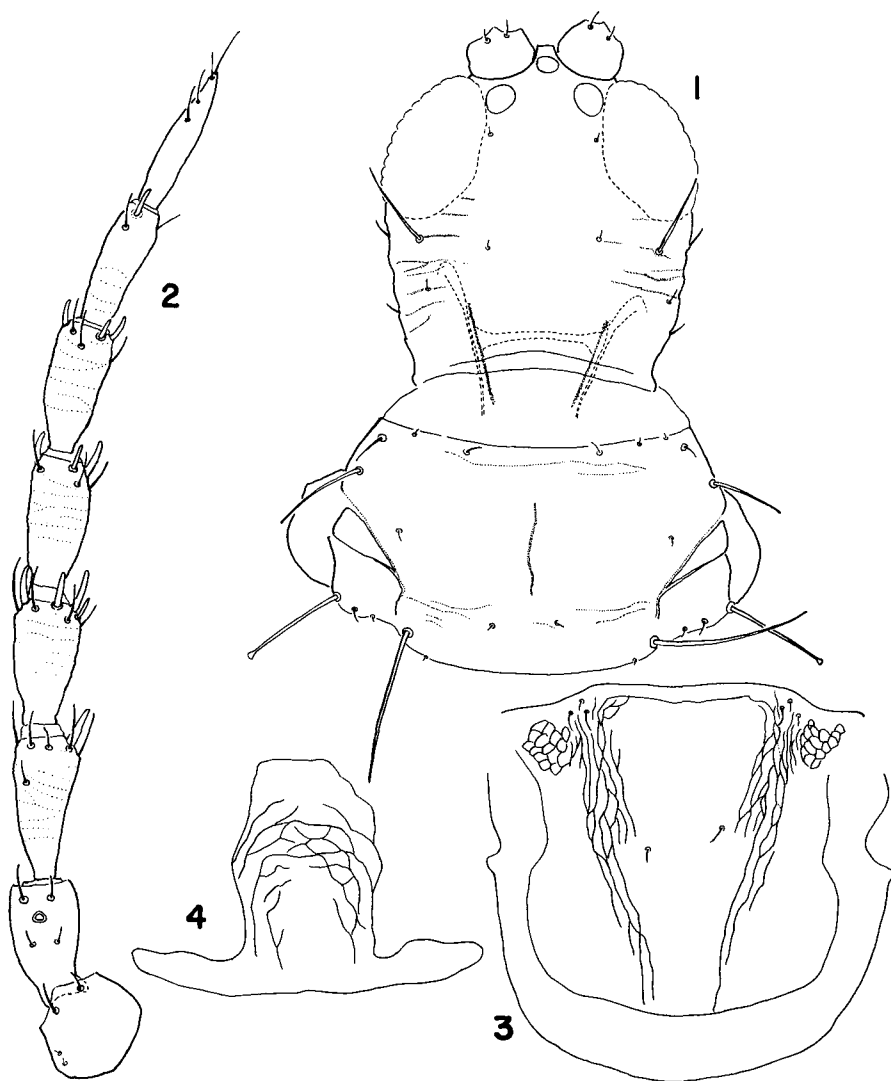


Fig.4. *Litotetothrips pinanganus*, ♀. 1. head and pronotum. 2. right antenna. 3. metanotum. 4. pelta.

Measurements ( $\mu\text{m}$ ). Body L 2.3-2.4 mm. Head L 222-224, W 232-234; OOD 188-192; POS 60-68. Pronotum L 160-168; AAS 10-24, AMS 10-12, MLS 64-74, PAS 106-116 EPS 80-84. Fore wing subbasal  $B_1$  8-16,  $B_2$  14-38,  $B_3$  16-30.  $T_5$  lateral seta 102-104;  $T_9$  L 92-96;  $T_{10}$  L 180-184;  $B_1$  on  $T_9$  160-170,  $B_2$  150-160,  $B_3$  120-135. L (W) of antennal segments:  $A_3$  68-70 (30-32);  $A_4$  58-60 (34);  $A_5$  56-60 (28);  $A_6$  55-60 (26);  $A_7$  58-61 (20-21);  $A_8$  70 (13-14).

Male. Unknown.

Second instar larva. Generally yellow with some red hypodermal pigments; head, pronotal plates, legs and abdominal segments IX-XI brown; tibiae paler

apically.  $A_1$  and  $A_2$  dark brown;  $A_3$ - $A_7$  brown. Body setae brown, most of them arising from brown patch.

Head (Fig. 5.1)  $W/L$  1.3, with  $B_3$ ;  $T_9$   $L/W$  0.60;  $T_{10}$   $L/W$  1.00;  $T_{10}L/T_9L$  0.92. Antenna (Fig. 5.2): inner dorsal seta on  $A_2$  rounded apically, outer dorsal seta on  $A_2$  and inner one on  $A_3$  blunt; inner sense cone on  $A_4$  largest;  $A_3$ - $A_7$   $L/W$  2.27, 2.00, 2.44, 2.40 and 3.56 respectively;  $A_7L/A_6L$  0.89. Meso- and metanotum (Fig. 5.1) each submedially with 2 pairs of brown patches besides setal patches.  $B_1$  and  $B_2$  on  $T_8$  (Fig. 5.3) arising from a large brown patch (joined patches). Peritremes of all spiracles (Figs. 5.4, 5.5) completely encircling spiracular openings; most cells in peritremes roundly oval, similar in size and shape; peritreme of mesothoracic spiracle with about 25 cells, transversely oblong, being two cells thick anteriorly and posteriorly and three to four cells thick on each lateral side; peritreme of spiracle on abdominal segment VIII with 11 cells, two cells thick anteriorly.

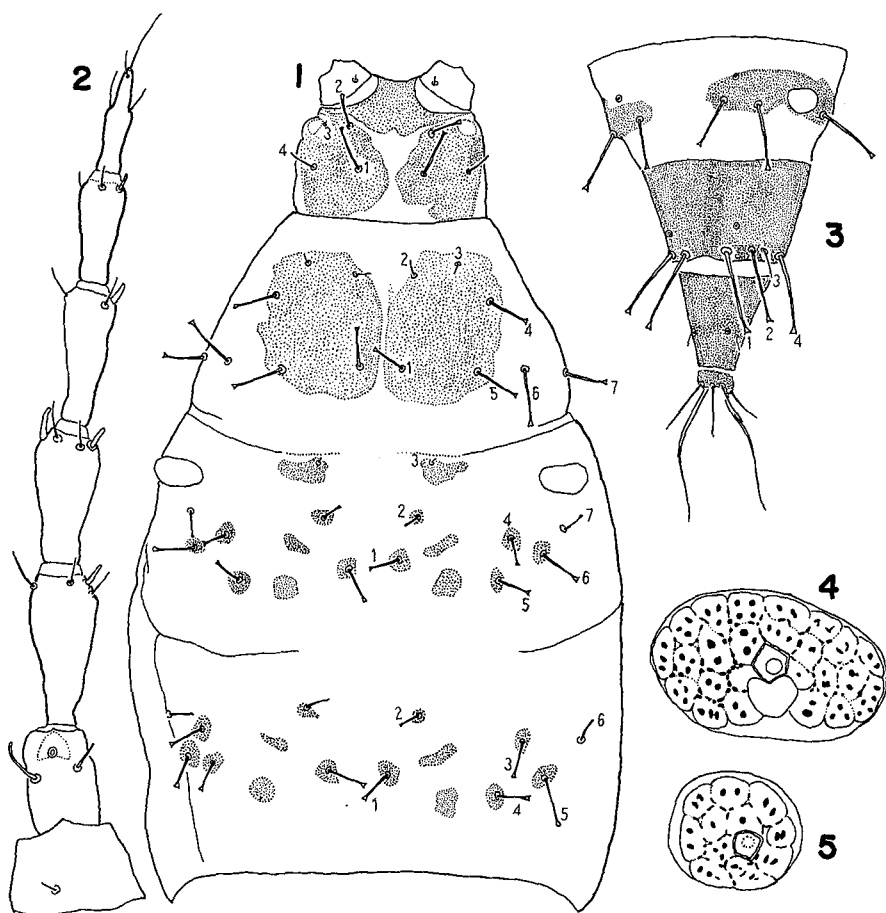


Fig. 5. *Litotetothrips pinanganus*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3.  $T_8$ - $T_{11}$ . 4. mesothoracic spiracle. 5. spiracle on abdominal segment VIII.

Dorsal setae on body mostly expanded apically, cephalic  $B_4$ , mesonotal  $B_7$  and metanotal  $B_2$  and  $B_6$  blunt, pronotal  $B_2$  and  $B_3$  pointed. Ventral setae mostly pointed apically,  $B_2$  on  $S_3$ - $S_5$  blunt, on  $S_8$  expanded. Cephalic  $B_1$  1.31 as long as  $B_2$ ,  $DB_2$ - $B_2$  (distance between  $B_2$  and  $B_2$ ) 2.15 as long as  $DB_1$ - $B_2$ . Pronotal  $B_1$  2.15 as long as  $B_2$ ,  $B_6$ / $B_7$  1.25-1.56,  $DB_1$ - $B_1$ / $DB_1$ - $B_2$  0.40; mesonotal  $B_1$  1.61 as long as  $B_2$ ,  $DB_1$ - $B_1$ / $DB_1$ - $B_2$  0.90-1.06; metanotal  $B_1$  0.94 as long as  $B_5$ .  $B_2$  on  $T_5$  1.03 as long as  $B_1$ ,  $DB_1$ - $B_1$ / $DB_1$ - $B_2$  1.14;  $B_3$  on  $T_7$  1.54-1.70 as long as  $B_1$ . Major setae on  $T_9$  subequal in length,  $B_1$  0.83,  $B_2$  0.78 and  $B_4$  0.81 as long as  $T_9$  respectively. Anal seta about 1.4 as long as  $T_{10}$ .

Measurements ( $\mu$ m). Body L 1.6 mm. Head L, mid dorsal 106, including mouth cone 198, W 138;  $T_9$  L 72, W 120;  $T_{10}$  L 66, W 66. L (W) of antennal segments:  $A_3$  50 (22);  $A_4$  44 (22);  $A_5$  44 (18);  $A_6$  36 (15);  $A_7$  32 (9). Cephalic  $B_1$  34,  $B_2$  26,  $B_4$  20. Pronotal  $B_1$  28,  $B_2$  13,  $B_3$  8,  $B_4$  32-36,  $B_5$  34-42,  $B_6$  40-50,  $B_7$  32. Mesonotal  $B_1$  29,  $B_2$  18,  $B_6$  34,  $B_7$  20; metanotal  $B_1$  32,  $B_5$  34.  $B_1$  on  $T_5$  35,  $B_2$  36,  $B_3$  58;  $B_1$  on  $T_9$  60,  $B_2$  56,  $B_4$  58; anal seta ca. 95.

Specimens examined. Semenanjung Malaysia — Pulau Pinang: Bukit Bendera (700 m), holotype ( $\varphi$ ), 1  $\varphi$  & 1 larva (*Engelhardtia spicata*, Juglandaceae), XI. 19. 1991.

Remarks. This is the largest species of the genus. It is unique in the unsculptured head and thorax, and distinguished from *L. rotundus* by  $A_4$  with three major sense cones and by  $A_3$  with some setae along with primary setae.

*Litotetothrips medangteja* n. sp.

Female. Brown, head darkest. Coxae brown; fore leg pale yellow, femur brown at extreme base and along outer margin; mid and hind femora brown; mid and hind tibiae and tarsi pale yellow.  $A_1$  and  $A_2$  brown;  $A_3$ - $A_8$  yellow. Wings pale, scale brownish.

Head (Fig. 6.1) sculptured with transversely anastomosing striae; maxillary stylet not reaching POS; maxillary bridge weakly present; POS pointed apically. Antenna (Fig. 6.2) slender;  $A_4$  with 3 major sense cones and 1 minor cone;  $A_3$ - $A_7$  usually with 6, 5, 6, 6 or 7, and 6 primary setae respectively;  $A_3$  with a seta at middle of inner margin along with primary setae;  $A_6$  with 2 major sense cones and 1 minor cone. Pronotum (Fig. 6.1) weakly sculptured nearly throughout; MLS and EPS blunt apically. Metanotum (Fig. 6.3) weakly reticulate medially; mesopresternum well represented. Fore wing with duplicate FH; without subbasal  $B_1$ . Pelta (Fig. 6.4) irregularly reticulate, without campaniform sensilla; lateral lobes narrow, occasionally reduced. Tergal lateral setae blunt apically;  $B_3$  on  $T_9$  longer than  $T_9$ . Body L 1.8-2.1 mm. Some quantitative characterers are given in Table 1 and measurements of body parts in Table 2.

Male. Colored as in female.  $A_3$ - $A_7$  usually with 6, 6, 6, 6 or 7, and 6 primary setae respectively. Fore wing rarely with subbasal  $B_1$ .  $B_1$  and  $B_3$  on  $T_9$  (Fig. 6.5) long,  $B_2$  short. Body L 1.4-1.8 mm. Biometric data in Table 1 and 2.

Second instar larva. Generally colored as in *L. pinanganus*; tibiae yellow, brownish basally.  $A_1$  and  $A_2$  brown;  $A_3$ - $A_7$  yellow.

Head (Fig. 7.1) W/L 1.2-1.3, with  $B_3$ ;  $T_9$  L/W 0.72-0.84;  $T_{10}$  L/W 1.19-1.63;  $T_{10}$ L/ $T_9$ L 0.92-1.03. Antenna (Fig. 7.2) slender, particularly  $A_5$ - $A_7$ ; inner dorsal

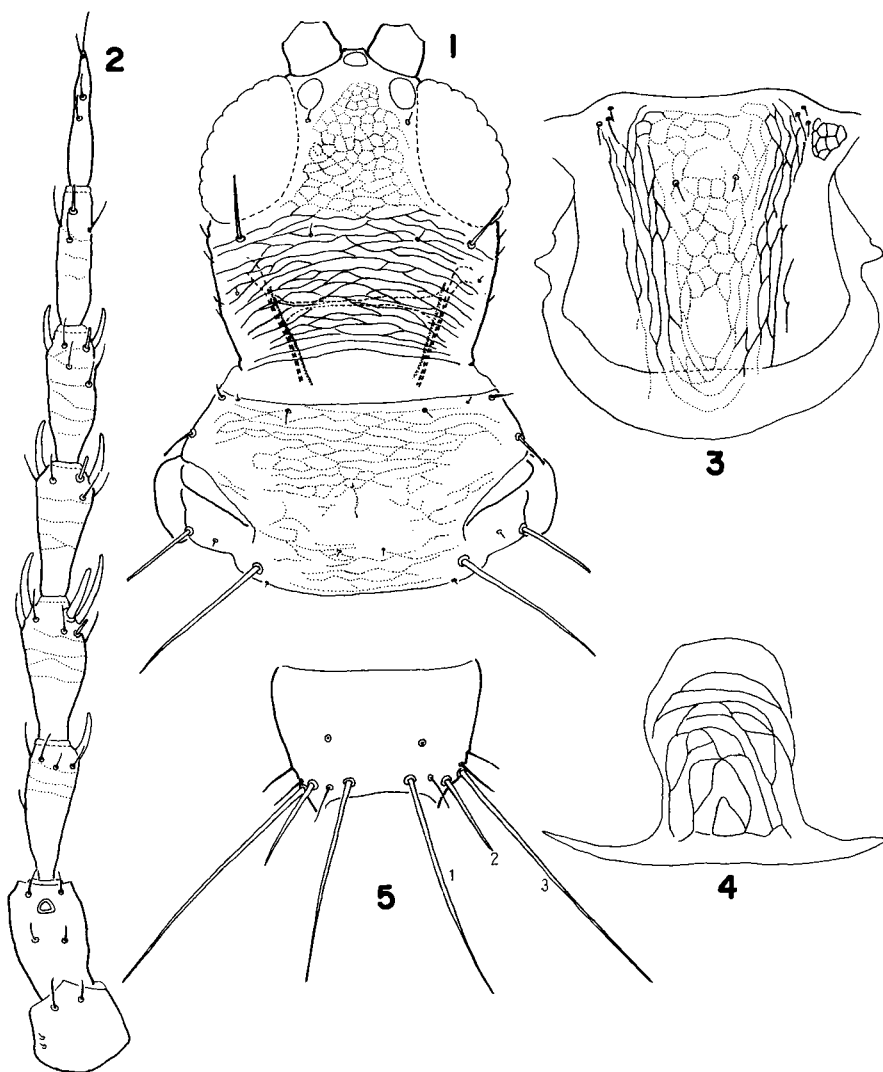


Fig. 6. *Litotetothrips medangteja*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, T<sub>9</sub>.

seta on A<sub>2</sub> alone blunt apically ; A<sub>3</sub>-A<sub>7</sub> L/W 2.17-2.50, 2.14-2.40, 2.39-2.71, 3.00-3.54 and 4.75-5.71 respectively ; A<sub>7</sub>L/A<sub>6</sub>L 0.79-0.95. Meso- and metanotum with only setal brown patches ; B<sub>1</sub> and B<sub>2</sub> on T<sub>8</sub> (Fig. 7.3) arising each from a brown patch. Spiracles similar to those of *L. pinanganus* ; peritreme of mesothoracic spiracle with about 30-35 cells, that on segment II with about 15, on segment VIII with about 20.

Dorsal setae on body shorter than the congeners, particularly on head and thorax, mostly blunt or slightly expanded apically ; cephalic B<sub>4</sub>, pronotal B<sub>2</sub>, B<sub>3</sub> and B<sub>7</sub>, mesonotal B<sub>7</sub>, and metanotal B<sub>6</sub> pointed. Ventral setae mostly pointed ; B<sub>2</sub> on

Table 1. Quantitative characters in *Litotetothrips medangteja*.

Characters	Female		Male	
Head W/L	1.00-1.26	(1.07±0.05) 23	1.04-1.16	(1.10±0.03) 31
IOD/HOW	1.73-2.30	(2.01±0.12) 22	1.70-2.38	(2.01±0.15) 30
OOD/IOD	3.91-4.79	(4.46±0.21) 22	4.05-4.76	(4.39±0.20) 29
OOD/pronotum L	1.25-1.37	(1.29±0.03) 20	1.21-1.34	(1.27±0.04) 27
POS/OOD	0.26-0.34	(0.29±0.02) 20	0.22-0.36	(0.28±0.04) 29
A <sub>3</sub> L/W	2.23-2.64	(2.41±0.10) 23	2.25-2.73	(2.44±0.11) 32
A <sub>4</sub> L/W	1.73-2.10	(1.94±0.08) 23	1.66-1.93	(1.80±0.06) 32
A <sub>5</sub> L/W	2.00-2.31	(2.15±0.08) 23	1.85-2.29	(2.07±0.10) 32
A <sub>6</sub> L/W	2.25-2.77	(2.49±0.13) 23	2.00-2.70	(2.33±0.14) 32
A <sub>7</sub> L/W	2.78-3.61	(3.20±0.21) 23	2.56-3.29	(2.97±0.17) 32
A <sub>8</sub> L/W	4.83-5.73	(5.29±0.26) 23	4.60-5.70	(5.16±0.27) 31
A <sub>6</sub> L/A <sub>3</sub> L	0.91-1.05	(0.97±0.04) 23	0.86-1.00	(0.92±0.04) 32
A <sub>8</sub> L/A <sub>7</sub> L	0.96-1.14	(1.03±0.04) 23	0.96-1.17	(1.06±0.06) 31
MLS/pronotum L	0.13-0.26	(0.18±0.04) 21	0.11-0.27	(0.19±0.04) 26
PAS/pronotum L	0.69-0.87	(0.76±0.05) 24	0.63-0.84	(0.75±0.05) 32
EPS/pronotum L	0.33-0.47	(0.38±0.03) 22	0.30-0.42	(0.37±0.03) 31
AMSD/MSD	0.82-1.63	(1.06±0.16) 34	0.81-1.90	(1.31±0.24) 52
T <sub>10</sub> L/OOD	0.88-1.08	(0.91±0.04) 23	0.85-0.94	(0.89±0.03) 27
T <sub>9</sub> B <sub>1</sub> /T <sub>9</sub> L	1.74-2.37	(1.89±0.10) 21	1.63-1.97	(1.78±0.10) 34
T <sub>9</sub> B <sub>2</sub> /T <sub>9</sub> L	2.03-2.38	(2.22±0.10) 23	0.53-0.76	(0.67±0.05) 32
T <sub>9</sub> B <sub>3</sub> /T <sub>9</sub> L	1.22-1.55	(1.41±0.09) 18	1.92-2.34	(2.12±0.11) 34
No. setae on A <sub>3</sub>	5-6	(5.8±0.4) 31	5-6	(5.9±0.3) 34
Do. on A <sub>4</sub>	4-6	(5.0±0.3) 31	5-6	(5.9±0.3) 34
Do. on A <sub>5</sub>	5-7	(5.9±0.4) 31	4-7	(6.0±0.4) 34
Do. on A <sub>6</sub>	6-7	(6.5±0.5) 31	6-7	(6.6±0.6) 34
Do. on A <sub>7</sub>	5-6	(5.9±0.3) 31	6	(6.0±0.0) 34
No. pronotal setae	17-20	(18.1±0.7) 23	17-21	(18.3±0.9) 32
No. metanepimeral setae	6-10	(7.8±0.9) 42	5-8	(7.2±0.7) 51
No. mesosternal setae	9-14	(11.7±1.1) 18	9-13	(11.4±1.1) 29
No. metasternal setae	21-30	(25.2±2.5) 21	24-30	(26.6±1.8) 31
No. discal setae on S <sub>5</sub>	5-10	(6.9±1.7) 20	4-11	(6.1±1.2) 33
No. FH on fore wing	90-111	(102.0±3.9) 31	87-106	(95.7±4.2) 33
No. duplicate FH	5-10	(7.3±1.0) 34	5-9	(6.9±1.0) 44
No. FH on hind wing	92-107	(100.0±4.1) 24	84-101	(93.0±4.3) 30

Range, mean±SD (in parentheses), and number of specimens examined are given in the mentioned order.

S<sub>3</sub>-S<sub>5</sub> always and on S<sub>6</sub> occasionally blunt. Cephalic B<sub>1</sub> 1.83-2.17 as long as B<sub>2</sub>, B<sub>4</sub> small; DB<sub>2</sub>-B<sub>2</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.93-2.64. Pronotal B<sub>1</sub> 3.00-4.00 as long as B<sub>2</sub>; B<sub>6</sub>/B<sub>7</sub> 1.82-3.20; DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 0.33-0.46. Mesonotal B<sub>1</sub> 1.60-2.00 as long as B<sub>2</sub>; DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.25-1.55. Metanotal B<sub>1</sub> 0.61-0.73 as long as B<sub>5</sub>. B<sub>2</sub> on T<sub>5</sub> 1.20-1.33 as long as B<sub>1</sub>; DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 0.75-1.04. B<sub>3</sub> on T<sub>7</sub> long, 2.52-2.92 as long as B<sub>1</sub>. B<sub>2</sub> on T<sub>9</sub> clearly shorter than B<sub>1</sub> and B<sub>4</sub>; B<sub>1</sub> 1.24-1.80, B<sub>2</sub> 0.79-1.00 and B<sub>4</sub> 1.18-1.38 as long as

Table 2. Measurements of body parts in *Litotetothrips medangteja*, in micra.

Characters	Female	Male
Head L	188-222 (207±6.7) 23	166-200 (181±7.0) 31
Head W	212-236 (222±6.4) 23	186-210 (199±4.6) 31
OOD	170-192 (179±5.2) 20	140-166 (156±5.9) 29
POS	44-62 (52±4.2) 20	34-56 (44±6.5) 30
A <sub>3</sub> L	58-66 (61±2.1) 23	50-60 (56±2.3) 32
A <sub>3</sub> W	24-27 (25±0.8) 23	21-24 (23±1.1) 32
A <sub>4</sub> L	52-65 (59±2.4) 23	45-54 (51±2.3) 32
A <sub>4</sub> W	29-32 (31±0.8) 23	26-30 (28±1.0) 32
A <sub>5</sub> L	54-64 (59±2.3) 23	48-55 (51±1.9) 32
A <sub>5</sub> W	26-30 (27±1.2) 23	22-26 (25±1.1) 32
A <sub>6</sub> L	54-62 (60±2.1) 23	44-55 (51±2.7) 32
A <sub>6</sub> W	22-26 (24±1.1) 23	20-24 (22±1.0) 32
A <sub>7</sub> L	50-65 (59±3.2) 23	44-56 (49±2.7) 32
A <sub>7</sub> W	18-20 (18±0.7) 23	16-18 (17±0.7) 32
A <sub>8</sub> L	54-68 (60±3.5) 23	46-57 (52±2.6) 32
A <sub>8</sub> W	11-12 (11±0.5) 23	9-11 (10±0.4) 32
Pronotum L	126-148 (139±5.0) 23	106-138 (123±6.4) 31
MLS	18-38 (25±6.0) 21	12-32 (23±5.2) 26
PAS	92-122 (105±8.8) 24	80-103 (91±6.2) 32
EPS	46-68 (53±5.4) 22	32-56 (45±4.7) 31
Fore wing subbasal B <sub>1</sub>	absent	absent
Do. B <sub>2</sub>	35-58 (47±5.8) 25	22-48 (37±6.3) 39
Do. B <sub>3</sub>	22-48 (33±6.0) 25	12-33 (25±5.1) 39
T <sub>5</sub> lateral seta	80-116 (95±9.1) 21	68-90 (80±5.5) 30
T <sub>9</sub> L	80-86 (82±2.3) 23	70-82 (78±2.9) 32
T <sub>10</sub> L	156-170 (162±4.2) 23	120-154 (139±6.8) 32
T <sub>9</sub> B <sub>1</sub>	144-172 (156±9.5) 21	124-154 (138±7.7) 34
T <sub>9</sub> B <sub>2</sub>	162-204 (182±9.5) 23	32-60 (52±5.1) 32
T <sub>9</sub> B <sub>3</sub>	100-128 (117±7.1) 18	150-186 (164±10.4) 34

T<sub>9</sub> respectively. Anal seta about 1.0-1.2 as long as T<sub>10</sub>.

Measurements (μm). Body L 1.1-1.3 mm. Head L, mid dorsal 94-108, including mouth cone 172-180, W 120-132; T<sub>9</sub> L 70-80, W 87-106; T<sub>10</sub> L 70-76, W 43-61. L (W) of antennal segments: A<sub>3</sub> 46-51 (20-23); A<sub>4</sub> 45-48 (20-21); A<sub>5</sub> 43-46 (17-18); A<sub>6</sub> 42-48 (13-14); A<sub>7</sub> 38-42 (7-8). Cephalic B<sub>1</sub> 22-28, B<sub>2</sub> 12-14, B<sub>4</sub> 6-9. Pronotal B<sub>1</sub> 18-24, B<sub>2</sub> 5-8, B<sub>3</sub> 3-4, B<sub>4</sub> 17-20, B<sub>5</sub> 18-22, B<sub>6</sub> 20-32, B<sub>7</sub> 10-13. Mesonotal B<sub>1</sub> 16-25, B<sub>2</sub> 10-14, B<sub>6</sub> 22-34, B<sub>7</sub> 4-10; metanotal B<sub>1</sub> 18-22, B<sub>5</sub> 24-34. B<sub>1</sub> on T<sub>5</sub> 16-20, B<sub>2</sub> 20-26, B<sub>3</sub> 38-44; B<sub>1</sub> on T<sub>7</sub> 20-24, B<sub>3</sub> 53-70; B<sub>1</sub> on T<sub>9</sub> 94-144, B<sub>2</sub> 60-80, B<sub>4</sub> 86-102.

Specimens examined. Semenanjung Malaysia — Selangor: Kuala Lumpur: Bukit Nanas, holotype (♀) 15♀ 33♂ & 7 larvae (*Cinnamomum iners*, Lauraceae, Malaysian name: medang teja), IX. 26. 1991; Templer Park, 1♀ (*C. iners*), VIII. 27. 1990; Kedah: Sik: Bukit Perangin, 6♀ 6♂ (*C. iners*), XI. 9. 1991.

Remarks. This species and *L. keladan* have no subbasal seta B<sub>1</sub> on the fore



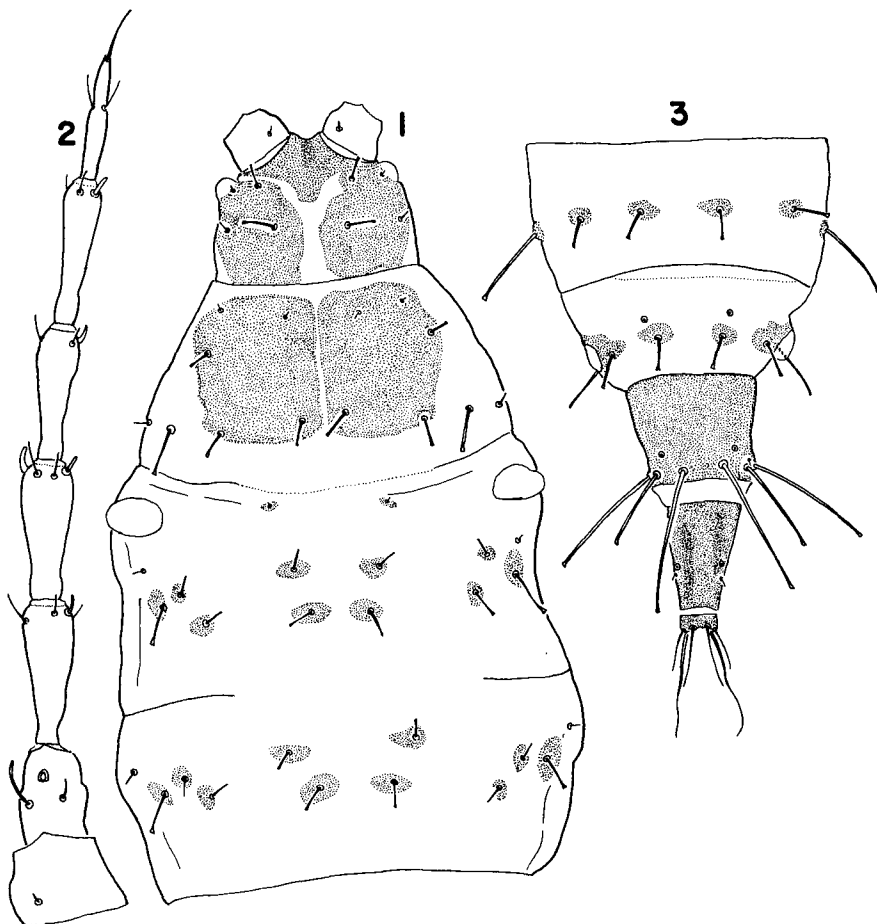


Fig. 7. *Litotetothrips medangteja*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T<sub>7</sub>-T<sub>11</sub>.

wing. *L. medangteja* is distinguished from *L. shoreae* by slender antennal segments, by A<sub>3</sub> with an additional seta at middle of inner margin, by the pelta with narrow lateral lobes, and by T<sub>9</sub> with long posteromarginal setae B<sub>1</sub> in the male. The second instar larva also has slender antenna, and differs from the congeners in having shorter setae on the head and thorax.

#### *Litotetothrips rotundus*

*Gynaikothrips rotundus* Moulton 1928 : 304-305.

*Litotetothrips rotundus*, Takahashi 1936, Philip. J. Sci. 60 : 444.

Adult. Legs dark brown ; fore tibia and tarsus yellow ; mid and hind tarsi pale brown. Head and posteromedian part of metanotum sculptured. Maxillary stylet just reaching below POS ; maxillary bridge absent. A<sub>4</sub> with 2 major sense cones

and a minor cone ;  $A_6$  without a major sense cone at outer apex ;  $A_3$ - $A_7$  usually with 5, 5, 6, 7 and 6 primary setae respectively ;  $A_3$  with only primary setae. Mesopres-  
ternum well represented. Fore wing with duplicate FH ; subbasal  $B_1$  occasionally  
absent. Tergal lateral setae usually pointed, occasionally blunt. In male  $T_9$  with  
short  $B_2$ , and long  $B_1$  and  $B_3$ . Body L 1.7-2.3 mm in female, 1.5-1.9 mm in male.  
Some quantitative characters are given in Table 3 and measurements of body parts  
in Table 4.

Second instar larva. Generally colored as in *L. pinanganus* ; tibiae pale brown.

Table 3. Quantitative characters in *Litotetothrips rotundus*.

Characters	Female	Male
Head W/L	0.95-1.04 ( $1.01 \pm 0.03$ ) 33	0.96-1.07 ( $1.01 \pm 0.03$ ) 11
IOD/HOW	1.80-2.44 ( $2.11 \pm 0.16$ ) 33	1.80-2.25 ( $2.08 \pm 0.14$ ) 11
OOD/IOD	4.05-4.95 ( $4.61 \pm 0.20$ ) 33	3.95-4.71 ( $4.41 \pm 0.21$ ) 11
OOD/pronotum L	1.27-1.40 ( $1.33 \pm 0.03$ ) 32	1.23-1.31 ( $1.28 \pm 0.03$ ) 11
POS/OOD	0.23-0.33 ( $0.28 \pm 0.02$ ) 27	0.20-0.27 ( $0.24 \pm 0.02$ ) 10
$A_3$ L/W	2.21-2.67 ( $2.41 \pm 0.10$ ) 32	2.32-2.64 ( $2.46 \pm 0.09$ ) 12
$A_4$ L/W	1.74-2.07 ( $1.91 \pm 0.09$ ) 32	1.77-2.00 ( $1.88 \pm 0.07$ ) 12
$A_5$ L/W	1.93-2.25 ( $2.09 \pm 0.11$ ) 32	1.96-2.16 ( $2.04 \pm 0.06$ ) 12
$A_6$ L/W	2.00-2.48 ( $2.18 \pm 0.13$ ) 32	2.00-2.30 ( $2.12 \pm 0.10$ ) 12
$A_7$ L/W	2.25-2.90 ( $2.61 \pm 0.16$ ) 32	2.29-2.79 ( $2.63 \pm 0.13$ ) 12
$A_8$ L/W	3.64-4.83 ( $4.34 \pm 0.28$ ) 32	4.00-4.45 ( $4.26 \pm 0.15$ ) 12
$A_6$ L/ $A_3$ L	0.86-0.98 ( $0.91 \pm 0.03$ ) 32	0.82-0.95 ( $0.90 \pm 0.04$ ) 12
$A_8$ L/ $A_7$ L	0.87-1.04 ( $0.97 \pm 0.04$ ) 32	0.92-1.02 ( $0.97 \pm 0.04$ ) 12
MLS/pronotum L	0.21-0.38 ( $0.32 \pm 0.04$ ) 28	0.21-0.36 ( $0.30 \pm 0.05$ ) 8
PAS/pronotum L	0.57-0.87 ( $0.78 \pm 0.06$ ) 31	0.46-0.74 ( $0.63 \pm 0.08$ ) 13
EPS/pronotum L	0.36-0.51 ( $0.43 \pm 0.04$ ) 32	0.32-0.43 ( $0.38 \pm 0.04$ ) 10
AMSD/MSD	1.58-3.00 ( $2.11 \pm 0.31$ ) 44	1.54-3.18 ( $2.14 \pm 0.51$ ) 15
$T_{10}$ L/OOD	0.76-0.90 ( $0.84 \pm 0.03$ ) 32	0.78-0.89 ( $0.83 \pm 0.03$ ) 10
$T_9B_1$ / $T_9$ L	1.63-2.05 ( $1.78 \pm 0.11$ ) 31	1.53-1.86 ( $1.69 \pm 0.12$ ) 12
$T_9B_2$ / $T_9$ L	1.91-2.44 ( $2.11 \pm 0.13$ ) 31	0.53-0.70 ( $0.62 \pm 0.05$ ) 12
$T_9B_3$ / $T_9$ L	1.22-1.71 ( $1.50 \pm 0.12$ ) 29	1.73-2.25 ( $1.95 \pm 0.15$ ) 12
No. setae on $A_3$	5-6 ( $5.1 \pm 0.4$ ) 50	4-6 ( $5.0 \pm 0.4$ ) 27
Do. on $A_4$	5-6 ( $5.1 \pm 0.3$ ) 50	3-6 ( $5.0 \pm 0.5$ ) 27
Do. on $A_5$	5-7 ( $6.0 \pm 0.3$ ) 50	5-7 ( $6.0 \pm 0.3$ ) 27
Do. on $A_6$	6-7 ( $6.8 \pm 0.4$ ) 50	6-8 ( $7.0 \pm 0.3$ ) 27
Do. on $A_7$	6 ( $6.0 \pm 0.0$ ) 50	5-6 ( $6.0 \pm 0.2$ ) 27
No. pronotal setae	17-22 ( $19.6 \pm 1.4$ ) 33	17-22 ( $18.8 \pm 1.5$ ) 11
No. metanepimeral setae	5-8 ( $6.7 \pm 0.9$ ) 42	5-8 ( $6.7 \pm 0.8$ ) 15
No. mesosternal setae	12-18 ( $14.5 \pm 1.8$ ) 28	12-17 ( $14.5 \pm 2.0$ ) 10
No. metasternal setae	20-33 ( $26.8 \pm 3.2$ ) 28	21-32 ( $27.9 \pm 3.2$ ) 10
No. discal setae on $S_5$	5-9 ( $7.5 \pm 1.0$ ) 32	6-8 ( $7.4 \pm 0.7$ ) 10
No. FH on fore wing	90-111 ( $99.5 \pm 4.6$ ) 33	90-106 ( $96.1 \pm 5.1$ ) 18
No. duplicate FH	3-10 ( $6.0 \pm 1.6$ ) 35	3-8 ( $6.1 \pm 1.5$ ) 14
No. FH on hind wing	92-112 ( $98.9 \pm 5.2$ ) 27	89-103 ( $93.8 \pm 4.7$ ) 12

Table 4. Measurements of body parts in *Lilotetothrips rotundus*, in micra.

Characters	Female	Male
Head L	186-236 (212±10.3) 33	174-202 (193±9.2) 11
Head W	190-230 (214±8.6) 33	183-206 (195±6.8) 11
OOD	162-206 (185±9.7) 33	150-176 (165±7.9) 11
POS	40-60 (52±5.7) 27	32-48 (40±5.0) 10
A <sub>3</sub> L	54-72 (63±4.3) 32	54-60 (58±1.7) 12
A <sub>3</sub> W	21-30 (26±1.9) 32	22-25 (23±0.9) 12
A <sub>4</sub> L	48-66 (58±4.5) 32	46-56 (53±2.7) 12
A <sub>4</sub> W	26-36 (31±2.1) 32	26-30 (28±1.4) 12
A <sub>5</sub> L	50-66 (59±4.0) 32	48-58 (54±3.0) 12
A <sub>5</sub> W	24-34 (28±1.8) 32	24-28 (26±1.3) 12
A <sub>6</sub> L	50-64 (57±3.6) 32	46-54 (52±2.7) 12
A <sub>6</sub> W	23-30 (26±1.5) 32	23-26 (24±1.2) 12
A <sub>7</sub> L	51-62 (56±2.7) 32	48-54 (52±2.2) 12
A <sub>7</sub> W	19-24 (22±1.1) 32	18-21 (20±0.9) 12
A <sub>8</sub> L	48-62 (55±3.1) 32	46-53 (50±1.9) 12
A <sub>8</sub> W	11-14 (13±0.8) 32	11-13 (12±0.6) 12
Pronotum L	116-157 (139±8.4) 33	122-140 (129±7.2) 11
MLS	26-60 (45±7.1) 28	26-48 (40±7.7) 8
PAS	80-130 (109±12.1) 31	74-90 (83±5.6) 13
EPS	42-72 (60±7.0) 32	42-60 (50±5.3) 10
Forewing subbasal B <sub>1</sub>	4-16 (7±2.3) 31	4-6 (6±0.8) 10
Do. B <sub>2</sub>	30-50 (42±3.9) 36	28-37 (33±2.7) 11
Do. B <sub>3</sub>	8-42 (19±8.0) 36	12-34 (21±9.0) 11
T <sub>5</sub> lateral seta	76-106 (92±8.7) 30	64-82 (75±4.9) 10
T <sub>9</sub> L	70-92 (82±4.9) 33	80-86 (83±2.4) 11
T <sub>10</sub> L	130-174 (155±8.7) 33	128-146 (137±5.7) 11
T <sub>9</sub> B <sub>1</sub>	116-160 (144±11.3) 31	126-158 (141±12.7) 12
T <sub>9</sub> B <sub>2</sub>	152-200 (173±10.6) 31	42-60 (51±4.8) 12
T <sub>9</sub> B <sub>3</sub>	100-146 (123±11.3) 29	142-180 (162±12.4) 12

A<sub>1</sub>, A<sub>2</sub> and A<sub>7</sub> brown, A<sub>1</sub> darkest ; A<sub>3</sub>-A<sub>6</sub> pale yellow, A<sub>6</sub> brownish apically.

Head (Fig. 8.1) W/L 1.1-1.2, with B<sub>3</sub> ; T<sub>9</sub> L/W 0.74-0.99 ; T<sub>10</sub> L/W 0.97-1.23 ; T<sub>10</sub>L/T<sub>9</sub>L 0.86-1.09. Antenna (Fig. 8.2) : dorsal setae on A<sub>2</sub> and inner seta on A<sub>3</sub> blunt apically ; A<sub>3</sub>-A<sub>7</sub> L/W 2.00-2.27, 1.92-2.21, 2.09-2.38, 2.40-2.79 and 3.11-3.88 respectively ; A<sub>6</sub>L/A<sub>3</sub>L 0.74-0.81 ; A<sub>7</sub>L/A<sub>6</sub>L 0.72-0.79. Meso- and metanotum with only setal brown patches. B<sub>1</sub> and B<sub>2</sub> on T<sub>8</sub> (Fig. 8.3) arising each from a brown patch. Spiracles similar to those of *L. pinanganus* ; peritreme of mesothoracic spiracle with about 25 cells, that on segment II about 18, on segment VIII with about 12.

Dorsal setae on body mostly expanded apically ; cephalic B<sub>4</sub>, pronotal B<sub>2</sub> and B<sub>3</sub>, mesonotal B<sub>7</sub> and metanotal B<sub>6</sub> pointed or occasionally blunt ; setae on T<sub>9</sub> also pointed. Ventral setae pointed except B<sub>2</sub> on S<sub>3</sub> blunt. Cephalic B<sub>1</sub> 1.22-1.61 as long as B<sub>2</sub> ; DB<sub>2</sub>-B<sub>2</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.66-1.82. Pronotal B<sub>1</sub> 1.00-1.67 as long as B<sub>2</sub> ; B<sub>6</sub>/B<sub>7</sub> 1.50-

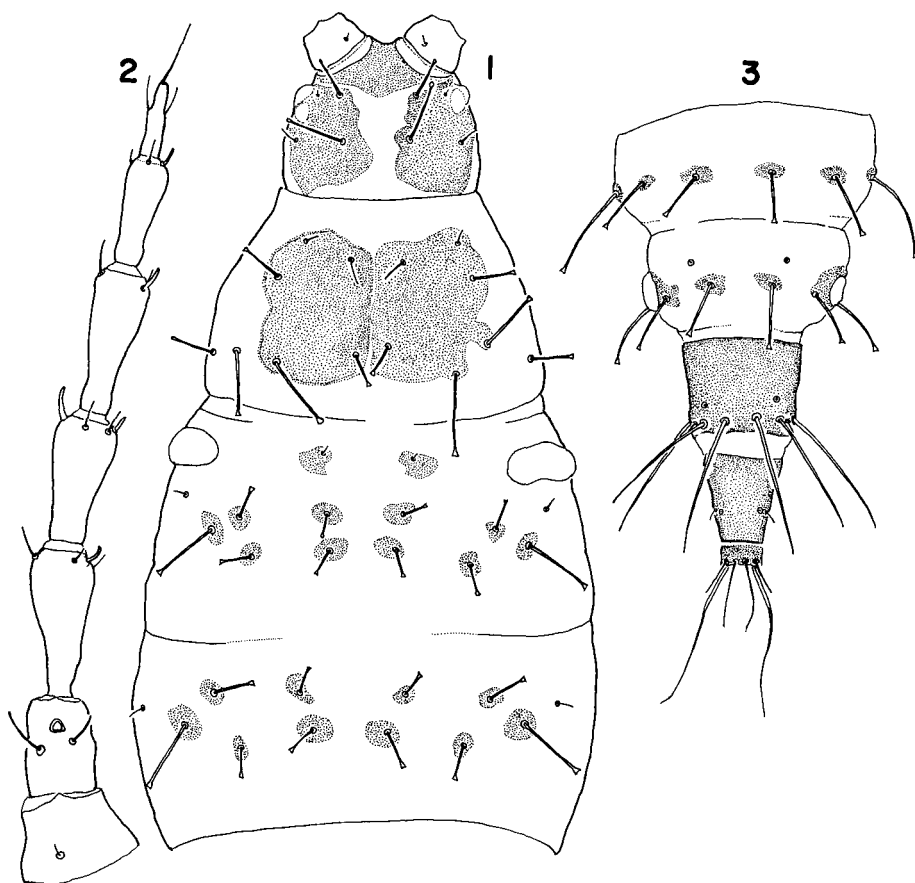


Fig. 8. *Litotetothrips rotundus*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T<sub>7</sub>-T<sub>11</sub>.

1.69; DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 0.37-0.53. Mesonotal B<sub>1</sub> 1.10-1.42 as long as B<sub>2</sub>; DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.38-2.63. Metanotal B<sub>1</sub> 0.56-0.77 as long as B<sub>5</sub>. B<sub>2</sub> on T<sub>5</sub> 1.29-1.41 as long as B<sub>1</sub>; DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 0.91-1.19; B<sub>3</sub> on T<sub>7</sub> 1.79-2.11 as long as B<sub>1</sub>. B<sub>2</sub> on T<sub>9</sub> shorter than B<sub>1</sub> and B<sub>4</sub>, B<sub>1</sub> 1.43-1.71, B<sub>2</sub> 1.19-1.42 and B<sub>4</sub> 1.41-1.56 as long as T<sub>9</sub> respectively. Anal seta about 1.6-2.1 as long as T<sub>10</sub>.

Measurements (μm). Body L 1.3-1.6 mm. Head L, dorsal 104-120, including mouth cone 190-200, W 114-130; T<sub>9</sub> L 62-70, W 79-94; T<sub>10</sub> L 60-74, W 56-62. L (W) of antennal segments: A<sub>3</sub> 46-54 (22-24); A<sub>4</sub> 46-53 (22-25); A<sub>5</sub> 43-50 (19-22); A<sub>6</sub> 36-42 (14-16); A<sub>7</sub> 28-33 (8-9). Cephalic B<sub>1</sub> 41-50, B<sub>2</sub> 30-34, B<sub>4</sub> 32-38. Pronotal B<sub>1</sub> 22-30, B<sub>2</sub> 18-22, B<sub>3</sub> 8-12, B<sub>4</sub> 32-38, B<sub>5</sub> 52-60, B<sub>6</sub> 50-54, B<sub>7</sub> 31-36. Mesonotal B<sub>1</sub> 22-32, B<sub>2</sub> 20-26, B<sub>6</sub> 46-54, B<sub>7</sub> 10-12; metanotal B<sub>1</sub> 28-34, B<sub>5</sub> 44-52. B<sub>1</sub> on T<sub>5</sub> 26-32, B<sub>2</sub> 35-45, B<sub>3</sub> 61-66; B<sub>1</sub> on T<sub>7</sub> 34-39, B<sub>3</sub> 64-78; B<sub>1</sub> on T<sub>9</sub> 94-114, B<sub>2</sub> 76-94, B<sub>4</sub> 90-106.

Specimens examined. Japan — Sizuoka: Udoyama, 32♀ 14♂ 7 larvae (*Cin-namomum japonicum*), 1♀ 3 larvae (*C. camphora*), VI. 10. 1992; Nagasaki: Inasayama, 1♀ 1♂ 1 larva (*C. japonicum*), X. 21. 1977; Kagosima: Ōdomari: Sata,

5 ♀ 1 ♂ (*C. japonicum*), X. 8. 1978; Okinawa: Itoman, 3 ♀ (*C. japonicum*), XII. 24. 1976.

Remarks. This species is unique in lacking maxillary bridge and an outer major sense cone on  $A_6$ . It is also remarkable for the occurrence of the same numbers of antennal setae in the male and the female and also of only five setae on  $A_3$ . In the second instar larva it is distinguished from the congeners by  $T_9$  with apically pointed setae.

*Litotetothrips pasaniae*

Kurosawa 1937: 219-221.

Adult. Legs dark brown; fore tibia and all tarsi yellow. Head and metanotum weakly sculptured; maxillary stylet reaching POS; maxillary bridge weakly present.  $A_4$  with 3 major sense cones;  $A_6$  with 2 major sense cones and 1 minor cone;  $A_3$ - $A_7$  with 6, 5, 5 or 6, 5, and 6 primary setae respectively in female, probably 6, 5, 7, 6 and 6 setae in male;  $A_3$  medially with 1-2 dorsal setae and 1 ventral seta along with primary setae. MLS pointed; mesopresternum well represented. Fore wing without duplicate FH; subbasal  $B_1$  or  $B_3$  occasionally absent. Tergal lateral setae pointed apically except on  $T_8$  blunt or expanded. In male  $T_9$  (L 86  $\mu$ m) with  $B_1$  (ca. 120  $\mu$ m), short and thick  $B_2$  (L 65  $\mu$ m, W 6  $\mu$ m), and short and thin  $B_3$  (28  $\mu$ m) as in *L. kochummeni* (cf. Fig. 2.6). Body L 1.6-1.9 mm in female, 1.4 mm in male. Some quantitative characters in female are given in Table 5 and measurements of body parts in Table 6.

Second instar larva. Generally colored as in *L. pinanganus*; legs brown, tibiae paler.  $A_1$  and  $A_2$  brown;  $A_3$ - $A_7$  pale brown,  $A_6$  and  $A_7$  darker.

Head (Fig. 9.1) W/L 1.0-1.2, with  $B_3$ ;  $T_9$  L/W 0.52-0.75;  $T_{10}$  L/W 1.03-1.22;  $T_{10}L/T_9L$  1.03-1.15. Antenna (Fig. 9.2): inner dorsal seta on  $A_2$  usually blunt apically;  $A_3$ - $A_7$  L/W 1.91-2.15, 1.86-2.10, 2.22-2.71, 2.64-3.08 and 3.50-3.88 respectively;  $A_6L/A_3L$  0.80-0.93;  $A_7L/A_6L$  0.70-0.84. Meso- and metanotum (Fig. 9.1) each submedially with 2 pairs of brown patches besides setal patches.  $B_1$  and  $B_2$  on  $T_8$  (Fig. 9.3) arising from a large brown patch (joined patches). Spiracles similar to those of *L. pinanganus* but much smaller: peritreme of mesothoracic spiracle with 15-18 cells, those on segments II and VIII each with 6-8 cells.

Dorsal setae on body mostly expanded apically; cephalic  $B_4$ , pronotal  $B_2$  and  $B_3$ , mesonotal  $B_7$ , and metanotal  $B_6$  pointed, particularly  $B_3$  on  $T_6$  and  $T_7$  (Fig. 9.3) gradually tapering. Ventral setae mostly pointed;  $B_2$  on  $S_3$ ,  $S_4$  and  $S_8$  expanded. Cephalic  $B_1$  1.47-1.76 as long as  $B_2$ ,  $DB_2$ - $B_2/DB_1$ - $B_2$  1.79-2.25. Pronotal  $B_1$  1.38-2.50 as long as  $B_2$ ;  $B_6/B_7$  0.98-1.21;  $DB_1$ - $B_1/DB_1$ - $B_2$  0.27-0.35. Mesonotal  $B_1$  1.22-1.62 as long as  $B_2$ ;  $DB_1$ - $B_1/DB_1$ - $B_2$  1.05-1.64; metanotal  $B_1$  0.85-0.97 as long as  $B_5$ .  $B_2$  on  $T_5$  1.00-1.17 as long as  $B_1$ ,  $DB_1$ - $B_1/DB_1$ - $B_2$  1.04-1.67;  $B_3$  on  $T_7$  long, curved, about 2.4-3.1 as long as  $B_1$ . Major setae on  $T_9$  subequal in length,  $B_1$  0.93-1.11,  $B_2$  0.86-1.07 and  $B_4$  0.91-1.07 as long as  $T_9$  respectively. Anal seta about 2.1-2.4 as long as  $T_{10}$ .

Measurements ( $\mu$ m). Body L 1.2-1.5 mm. Head L, mid dorsal 104-108, including mouth cone 170-192, W 112-124;  $T_9$  L 54-58, W 75-103;  $T_{10}$  L 58-62, W 50-60. L (W) of antennal segments:  $A_3$  43-46 (20-23);  $A_4$  40-44 (20-22);  $A_5$  40-46 (17-18);

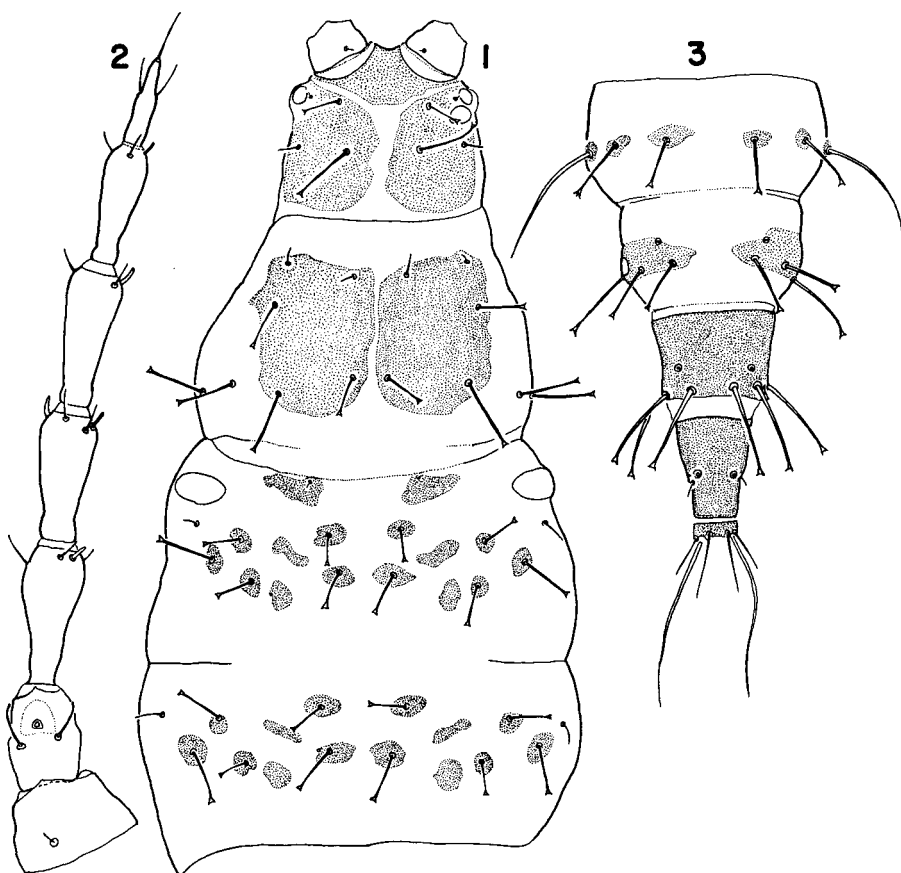


Fig. 9. *Litotetothrips pasaniae*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T<sub>7</sub>-T<sub>11</sub>.

A<sub>6</sub> 37-40 (12-14); A<sub>7</sub> 28-31 (8). Cephalic B<sub>1</sub> 38-47, B<sub>2</sub> 24-32, B<sub>4</sub> 14-18. Pronotal B<sub>1</sub> 22-30, B<sub>2</sub> 12-18, B<sub>3</sub> 8-14, B<sub>4</sub> 30-36, B<sub>5</sub> 36-55, B<sub>6</sub> 39-45, B<sub>7</sub> 36-46. Mesonotal B<sub>1</sub> 28-34, B<sub>2</sub> 21-24, B<sub>6</sub> 36-46, B<sub>7</sub> 12-18; metanotal B<sub>1</sub> 34-41, B<sub>5</sub> 38-45. B<sub>1</sub> on T<sub>5</sub> 26-31, B<sub>2</sub> 28-34, B<sub>3</sub> 50-60; B<sub>1</sub> on T<sub>7</sub> 30-34, B<sub>3</sub> 80-92; B<sub>1</sub> on T<sub>9</sub> 53-60, B<sub>2</sub> 50-58, B<sub>4</sub> 51-58.

Specimens examined. Japan—Sizuoka: Udoyama, 30 ♀ 8 larvae (*Castanopsis cuspidata*), VII. 13. 1992, 4 ♀ 1 ♂ (*C. cuspidata*), III. 2. 1972; Kôti: Suzaki: Urauti, 1 ♀ (*C. cuspidata*), VI. 5. 1982; Ôita: Ôta: Ono, 7 ♀ (*C. cuspidata*), IV. 30. 1976; Miyazaki: Nitinan: Udo, 1 ♀ (*C. cuspidata*), X. 26. 1977.

Remarks. This species has no remarkable characters. It is most closely related to *L. berangan* by A<sub>3</sub> with some additional setae, by A<sub>4</sub> with three major sense cones, and by the fore wing without duplicate FH, but is distinguished by thick A<sub>3</sub> (L/W 1.6-1.9) and by mid and hind tibiae brown. In the second instar larva it is distinguished from the congeners by T<sub>6</sub> and T<sub>7</sub> with B<sub>3</sub> gradually tapering.

*Litotetothrips roberti*

Kud6 1975 : 143-145.

Female. Legs dark brown ; fore tibia brown basally, yellow apically ; mid and hind tarsi pale brown, fore tarsus yellow. Head weakly sculptured in posterior half ; maxillary stylets inserted into POS but not spaced as much as POS ; maxillary bridge well represented. A<sub>4</sub> with 2 major sense cones and 1 minor cone ; A<sub>3</sub>-

Table 5. Quantitative characters in females of *Litotetothrips pasaniae* and *L. roberti*.

Characters	<i>L. pasaniae</i>	<i>L. roberti</i>
Head W/L	1.02-1.20 (1.11±0.05) 27	1.02-1.14 (1.08±0.03) 32
IOD/HOW	2.33-3.71 (2.94±0.37) 29	1.90-2.63 (2.15±0.19) 34
OOD/IOD	2.43-3.48 (2.92±0.30) 27	3.24-3.89 (3.57±0.16) 31
OOD/pronotum L	1.08-1.22 (1.16±0.04) 27	1.04-1.20 (1.11±0.04) 31
POS/OOD	0.31-0.41 (0.36±0.03) 21	0.33-0.52 (0.43±0.05) 30
A <sub>3</sub> L/W	1.66-1.92 (1.80±0.08) 27	1.93-2.42 (2.12±0.13) 31
A <sub>4</sub> L/W	1.45-1.84 (1.62±0.10) 27	1.50-2.00 (1.68±0.11) 31
A <sub>5</sub> L/W	1.56-2.00 (1.77±0.12) 27	1.62-1.96 (1.79±0.09) 31
A <sub>6</sub> L/W	1.58-2.10 (1.90±0.15) 27	1.71-2.04 (1.89±0.08) 31
A <sub>7</sub> L/W	2.28-3.00 (2.63±0.19) 27	2.10-2.78 (2.41±0.14) 31
A <sub>8</sub> L/W	4.36-6.00 (4.93±0.38) 27	3.93-5.80 (4.67±0.35) 31
A <sub>6</sub> L/A <sub>3</sub> L	0.83-0.96 (0.89±0.04) 27	0.77-0.90 (0.84±0.03) 31
A <sub>8</sub> L/A <sub>7</sub> L	1.06-1.24 (1.16±0.04) 27	1.03-1.27 (1.17±0.05) 31
MLS/pronotum L	0.27-0.41 (0.35±0.04) 15	0.28-0.45 (0.37±0.05) 31
PAS/pronotum L	0.61-0.85 (0.74±0.06) 26	0.60-0.68 (0.63±0.03) 31
EPS/pronotum L	0.42-0.62 (0.54±0.05) 22	0.47-0.60 (0.53±0.03) 31
AMSD/MSD	0.95-1.44 (1.15±0.12) 30	0.77-1.34 (1.04±0.12) 40
T <sub>10</sub> L/OOD	0.90-1.11 (0.99±0.06) 26	0.96-1.11 (1.04±0.04) 31
T <sub>9</sub> B <sub>1</sub> /T <sub>9</sub> L	1.71-2.18 (1.83±0.11) 26	1.37-1.74 (1.56±0.09) 32
T <sub>9</sub> B <sub>2</sub> /T <sub>9</sub> L	1.94-2.44 (2.08±0.11) 26	1.50-2.11 (1.88±0.13) 32
T <sub>9</sub> B <sub>3</sub> /T <sub>9</sub> L	1.0-1.4 (1.24±0.11) 14	1.0-1.3 (1.20±0.09) 19
No. setae on A <sub>3</sub>	5-6 (6.0±0.1) 50	5-7 (6.0±0.2) 50
Do. on A <sub>4</sub>	5 (5.0±0.0) 50	4-6 (5.1±0.3) 50
Do. on A <sub>5</sub>	5-7 (5.7±0.5) 50	4-6 (4.9±0.4) 50
Do. on A <sub>6</sub>	4-6 (5.3±0.6) 50	4-6 (5.0±0.6) 50
Do. on A <sub>7</sub>	5-6 (5.9±0.2) 50	5-6 (5.9±0.3) 50
No. pronotal setae	15-22 (19.2±1.9) 26	15-19 (16.8±1.2) 32
No. metanepimeral setae	6-8 (6.5±0.6) 30	6-9 (6.9±0.8) 34
No. mesosternal setae	12-16 (13.9±1.3) 17	12-17 (13.5±1.5) 28
No. metasternal setae	20-25 (22.9±1.5) 17	16-24 (20.6±1.8) 27
No. discal setae on S <sub>5</sub>	5-10 (7.1±1.5) 27	4-8 (5.6±1.0) 30
No. FH on fore wing	81-105 (92.7±4.6) 30	86-100 (93.5±3.9) 40
No. duplicate FH	absent	4-9 (6.5±1.1) 36
No. FH on hind wing	82-101 (90.1±4.9) 30	80-100 (89.2±4.7) 37

A<sub>7</sub> with 6, 5, 5 or 6, 5 and 6 primary setae respectively ; A<sub>3</sub> often with 1 ventral seta along with primary setae. MLS and EPS blunt apically ; mesopresternum rudimentary. Fore wing with duplicate FH ; any of subbasal setae occasionally absent. Pelta with a pair of campaniform sensilla ; tergal lateral setae blunt or pointed apically. Body L 1.7-1.9 mm. Some quantitative characters are given in Table 5 and measurements of body parts in Table 6. Male unknown.

Second instar larva. Generally colored as in *L. pinanganus* ; legs brown, tibiae yellow apically. A<sub>1</sub> and A<sub>2</sub> brown, A<sub>3</sub>-A<sub>7</sub> pale yellow, A<sub>7</sub> grayish.

Head (Fig. 10.1) W/L 1.1-1.3, without B<sub>3</sub> ; T<sub>9</sub> L/W 0.65-0.85 ; T<sub>10</sub> L/W 1.17-1.31 ; T<sub>10</sub> L/T<sub>9</sub>L 0.95-1.00. Antenna (Fig. 10.2) : inner dorsal seta on A<sub>2</sub> expanded or blunt apically, outer seta on A<sub>2</sub> and inner one on A<sub>3</sub> usually blunt ; A<sub>3</sub>-A<sub>7</sub> L/W 1.84-2.08, 2.00-2.18, 2.11-2.32, 2.53, and 3.50-4.00 respectively ; A<sub>6</sub>L/A<sub>3</sub>L 0.76-0.83 ; A<sub>7</sub>L/A<sub>6</sub>L 0.74-0.84. Meso- and metanotum each submedially with 2 pairs of brown

Table 6. Measurements of body parts in females of *Litotetothrips pasaniae* and *L. roberti*, in micra.

Characters	<i>L. pasaniae</i>	<i>L. roberti</i>
Head L	156-200 (172±10.2) 27	160-188 (173±6.5) 32
Head W	170-204 (190±6.5) 27	178-197 (187±4.9) 32
OOD	126-156 (141±6.6) 27	134-151 (144±4.7) 31
POS	42-59 (50±4.3) 21	44-74 (62±8.1) 30
A <sub>3</sub> L	42-52 (48±2.7) 27	52-62 (56±2.7) 31
A <sub>3</sub> W	23-29 (27±1.4) 27	24-28 (26±1.1) 31
A <sub>4</sub> L	40-52 (47±3.0) 27	42-54 (48±2.8) 31
A <sub>4</sub> W	25-31 (29±1.2) 27	27-31 (29±1.2) 31
A <sub>5</sub> L	38-53 (43±8.5) 27	42-50 (46±2.7) 31
A <sub>5</sub> W	24-27 (25±0.9) 27	24-28 (26±1.2) 31
A <sub>6</sub> L	33-50 (43±3.6) 27	41-50 (46±2.4) 31
A <sub>6</sub> W	21-24 (22±1.0) 27	23-26 (25±0.8) 31
A <sub>7</sub> L	39-50 (46±2.8) 27	42-52 (47±2.5) 31
A <sub>7</sub> W	16-20 (17±0.9) 27	18-22 (19±1.1) 31
A <sub>8</sub> L	46-61 (53±3.5) 27	48-60 (55±3.0) 31
A <sub>8</sub> W	9-12 (11±0.8) 27	10-14 (12±0.7) 31
Pronotum L	106-130 (122±5.5) 27	115-136 (130±5.3) 31
MLS	30-48 (41±5.5) 16	32-60 (48±7.1) 31
PAS	72-100 (91±6.8) 27	70-88 (82±4.0) 31
EPS	50-72 (65±5.2) 22	54-76 (69±5.4) 31
Fore wing subbasal B <sub>1</sub>	6-36 (17±6.4) 27	8-18 (13±2.1) 30
Do. B <sub>2</sub>	16-46 (31±6.5) 29	28-48 (36±4.3) 31
Do. B <sub>3</sub>	16-46 (31±6.8) 27	20-47 (31±5.1) 32
T <sub>5</sub> lateral seta	60-78 (72±4.8) 22	64-90 (79±6.7) 29
T <sub>9</sub> L	66-82 (75±4.5) 26	72-87 (80±3.4) 32
T <sub>10</sub> L	118-165 (140±12.9) 26	136-162 (151±6.8) 32
T <sub>9</sub> B <sub>1</sub>	116-148 (137±14.4) 26	112-136 (125±6.1) 32
T <sub>9</sub> B <sub>2</sub>	132-200 (155±15.4) 26	126-172 (152±9.3) 32
T <sub>9</sub> B <sub>3</sub> (roughly measured)	80-110 (93±8.0) 14	80-110 (96±8.0) 19



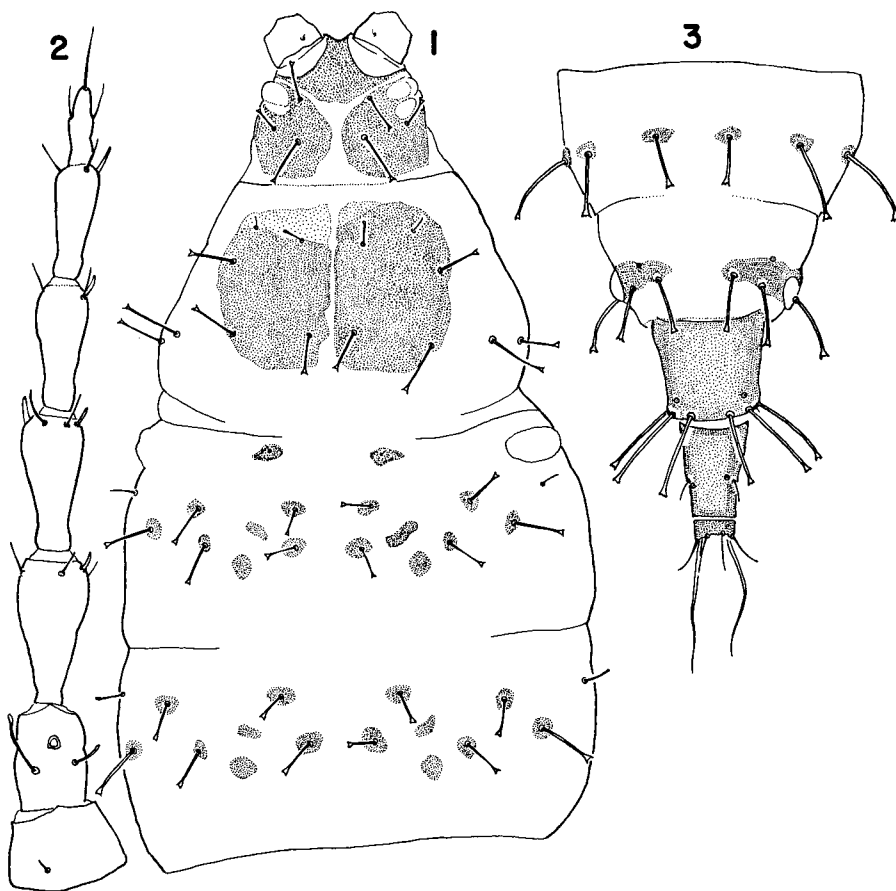


Fig. 10. *Litotetothrips roberti*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T<sub>7</sub>-T<sub>11</sub>.

patches besides setal patches. B<sub>1</sub> and B<sub>2</sub> on T<sub>8</sub> (Fig. 10.3) arising from a large brown patch (joined patches). Spiracles similar to those of *L. pinanganus* but smaller; peritreme of mesothoracic spiracle with 20-23 cells, that on segment II with 10-11.

Dorsal setae on body expanded apically; cephalic B<sub>4</sub> and pronotal B<sub>2</sub> occasionally pointed or blunt, pronotal B<sub>3</sub> and mesonotal B<sub>7</sub> pointed, metanotal B<sub>6</sub> blunt. Ventral setae mostly pointed; B<sub>2</sub> on S<sub>3</sub> and S<sub>4</sub> often blunt, on S<sub>8</sub> blunt or expanded. Cephalic B<sub>1</sub> 1.20-1.35 as long as B<sub>2</sub>, DB<sub>2</sub>-B<sub>2</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.61-2.08. Pronotal B<sub>1</sub> 1.41-1.75 as long as B<sub>2</sub>, B<sub>6</sub>/B<sub>7</sub> 1.11-1.31, DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 0.45-0.53. Mesonotal B<sub>1</sub> 1.09-1.60 as long as B<sub>2</sub>, DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.52-2.04; metanotal B<sub>1</sub> 0.68-0.84 as long as B<sub>5</sub>. B<sub>2</sub> on T<sub>5</sub> about 1.25 as long as B<sub>1</sub>, DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.17-1.56; B<sub>3</sub> on T<sub>7</sub> 1.50-1.67 as long as B<sub>1</sub>. Major setae on T<sub>9</sub> subequal in length, B<sub>1</sub> 0.91-1.02, B<sub>2</sub> 0.91-0.95 and B<sub>4</sub> 0.91-0.98 as long as T<sub>9</sub> respectively. Anal seta 1.7-2.0 as long as T<sub>10</sub>.

Measurements (μm). Body L 1.4-1.5 mm. Head L, mid dorsal 98-102, including mouth cone 164-186, W 112-120; T<sub>9</sub> L 63-66, W 78-102; T<sub>10</sub> L 63-68, W 48-58.

L (W) of antennal segments : A<sub>3</sub> 46-50 (24-25) ; A<sub>4</sub> 44-48 (22) ; A<sub>5</sub> 40-44 (19-20) ; A<sub>6</sub> 38 (18) ; A<sub>7</sub> 28-32 (8). Cephalic B<sub>1</sub> 36-42, B<sub>2</sub> 30-31, B<sub>4</sub> 22-26. Pronotal B<sub>1</sub> 30-35, B<sub>2</sub> 18-22, B<sub>3</sub> 12-14, B<sub>4</sub> 30-34, B<sub>5</sub> 40-48, B<sub>6</sub> 42-48, B<sub>7</sub> 35-38. Mesonotal B<sub>1</sub> 24-32, B<sub>2</sub> 20-22, B<sub>6</sub> 36-38, B<sub>7</sub> 18-22 ; metanotal B<sub>1</sub> 28-32, B<sub>5</sub> 38-42. B<sub>1</sub> on T<sub>5</sub> 32-34, B<sub>2</sub> 40-42, B<sub>3</sub> 54-60 ; B<sub>1</sub> on T<sub>7</sub> 35-40, B<sub>3</sub> 55-60 ; B<sub>1</sub> on T<sub>9</sub> 60-64, B<sub>2</sub> 60-61, B<sub>4</sub> 60-62.

Specimens examined. Japan — Niigata : Kanose : Tunogami, 1 ♀ (*Akebia quinata*), VIII. 26 1977 ; Nagano : Sinano : Noziri, 1 ♀ (*Quercus serrata*), VIII. 26. 1978 ; Sizuoka : Umegasima (700 m), 10 ♀ 4 larvae (*Q. serrata*), IX. 15. 1971, 18 ♀ (*Q. serrata*), X. 24. 1985 ; Mie : Nagasima : Higasinagasima, 4 ♀ (*Q. serrata*), X. 26. 1976 ; Yamaguti : Nagato : Senzaki, 1 ♀ (*Castanopsis cuspidata*), X. 17. 1976.

Remarks. This species is unique in having a pair of campaniform sensilla on the pelta and in the fore tibia brown basally. It is related to *L. keladan* by the rudimentary mesopresternum, the well-represented maxillary bridge and A<sub>4</sub> with two major sense cones, but is distinguished by the fore wing with duplicate FH. In the second larva it is distinguished from the congeners in having no cephalic B<sub>3</sub>.

#### KEY TO THE SPECIES

##### Female

1. Fore wing with duplicate FH ..... 2
- Fore wing without duplicate FH ..... 6
2. T<sub>1</sub> with a pair of campaniform sensilla on pelta ; mesopresternum clearly reduced ; fore tibia brown at least in basal half ; on *Quercus serrata* ..... *roberti*
- T<sub>1</sub> without campaniform sensilla on pelta ; mesopresternum well represented ; fore tibia yellow ..... 3
3. Mid and hind tibiae dark brown ..... 4
- Mid and hind tibiae yellow ..... 5
4. A<sub>4</sub> with 2 major sense cones ; A<sub>3</sub> with primary setae only ; A<sub>6</sub> without major sense cone at outer apex ; head sculptured posteriorly ; maxillary bridge absent ; OOD 1.3-1.4 as long as pronotum ; A<sub>8</sub> 0.9-1.0 as long as A<sub>7</sub> ; on *Cinnamomum japonicum* and *C. camphora* ..... *rotundus*
- A<sub>4</sub> (Fig. 4.2) with 3 major sense cones ; A<sub>3</sub> with some setae along with primary setae ; A<sub>6</sub> with major sense cone at outer apex ; head (Fig. 4.1) unsculptured ; maxillary bridge weakly present ; OOD 1.1-1.2 as long as pronotum ; A<sub>8</sub> 1.1-1.2 as long as A<sub>7</sub> ; on *Engelhardtia spicata* ..... *pinanganus*
5. Fore wing without subbasal B<sub>1</sub> ; A<sub>3</sub> 2.2-2.6 as long as wide ; MLS and EPS not expanded, only blunt apically ; on *Cinnamomum iners* ..... *medangteja*
- Fore wing with 3 subbasal setae ; A<sub>3</sub> scarcely 2.0 as long as wide ; MLS and EPS expanded apically ; on *Shorea leprosula* and *S. acuminata* ..... *shoreae*
6. Mesopresternum clearly reduced ; A<sub>3</sub> with primary setae only ; B<sub>3</sub> on T<sub>9</sub> about 0.5 as long as T<sub>9</sub> ; fore wing without subbasal B<sub>1</sub> ; on *Dryobalanops oblongifolia* ..... *keladan*
- Mesopresternum well represented ; A<sub>3</sub> with some setae along with primary setae ; B<sub>3</sub> on T<sub>9</sub> 1.0-1.6 as long as T<sub>9</sub> ; fore wing normally with 3 subbasal setae ; on *Castanopsis* ..... 7
7. Mid and hind tibiae dark brown ; A<sub>6</sub> usually with 5 setae ; on *C. cuspidata* ..... *pasaniae*
- Mid and hind tibiae yellow ; A<sub>6</sub> usually with 6 setae ..... 8
8. A<sub>4</sub> with 2 major sense cones ; B<sub>1</sub> and B<sub>2</sub> on T<sub>9</sub> 1.9-2.2 and 2.2-2.5 as long as T<sub>9</sub> respectively ; on *Castanopsis* sp. .... *kochummeni*
- A<sub>4</sub> with 3 major sense cones ; B<sub>1</sub> and B<sub>2</sub> on T<sub>9</sub> 1.5-1.8 and 1.9-2.1 as long as T<sub>9</sub> respectively ; on *C. schefferiana* ..... *berangan*

##### Male

1. Fore wing with duplicate FH ..... 2

- Fore wing without duplicate FH ..... 4
- 2. Mid and hind tibiae dark brown ; A<sub>4</sub> with 2 major sense cones ; A<sub>6</sub> without major sense cone at outer apex ; maxillary bridge absent ; on *Cinnamomum* ..... *rotundus*
- Mid and hind tibiae yellow ; A<sub>4</sub> with 3 major sense cones ; A<sub>6</sub> with major sense cone at outer apex ; maxillary bridge present ..... 3
- 3. B<sub>1</sub> on T<sub>9</sub> short, about 0.5 as long as B<sub>2</sub> ; A<sub>3</sub> scarcely 2.0 as long as wide ; fore wing with 3 subbasal setae ; on *Shorea* ..... *shoreae*
- B<sub>1</sub> on T<sub>9</sub> long, more than 2.0 as long as B<sub>2</sub> ; A<sub>3</sub> 2.3-2.7 as long as wide ; fore wing without subbasal B<sub>1</sub> ; on *Cinnamomum* ..... *medangteja*
- 4. B<sub>3</sub> on T<sub>9</sub> (Fig. 1.6) long, 1.9-2.1 as long as T<sub>9</sub> ; mesopresternum clearly reduced ; fore wing without subbasal B<sub>1</sub> ; on *Dryobalanops* ..... *keladan*
- B<sub>3</sub> on T<sub>9</sub> (Figs. 2.6, 3.6) short and thin, 0.3-0.4 as long as T<sub>9</sub> ; mesopresternum well represented ; fore wing normally with 3 subbasal setae ; on *Castanopsis* ..... 5
- 5. Mid and hind tibiae dark brown ..... *pasaniae*
- Mid and hind tibiae yellow ..... 6
- 6. A<sub>4</sub> with 2 major sense cones ; B<sub>2</sub> on T<sub>9</sub> 0.6-0.7 as long as T<sub>9</sub> ..... *kochummeni*
- A<sub>4</sub> with 3 major sense cones ; B<sub>2</sub> on T<sub>9</sub> 1.2-1.3 as long as T<sub>9</sub> ..... *berangan*

## Second instar larva

- 1. Meso- and metanotum (Fig. 5.1) each submedially with 2 pairs of brown patches besides setal patches ; B<sub>1</sub> and B<sub>2</sub> on T<sub>8</sub> (Fig. 5.3) arising from a large brown patch ; B<sub>1</sub>, B<sub>2</sub> and B<sub>4</sub> on T<sub>9</sub> clearly expanded apically, subequal in length ..... 2
- Meso- and metanotum (Fig. 7.1) with only setal brown patches ; B<sub>1</sub> and B<sub>2</sub> on T<sub>8</sub> (Fig. 7.3) arising each from a brown patch ; B<sub>1</sub>, B<sub>2</sub> and B<sub>4</sub> on T<sub>9</sub> not expanded, B<sub>2</sub> clearly shorter than B<sub>1</sub> and B<sub>4</sub> ; on *Cinnamomum* ..... 4
- 2. B<sub>3</sub> on T<sub>6</sub> and T<sub>7</sub> (Fig. 9.3) long, gradually tapering ; B<sub>3</sub> on T<sub>7</sub> 2.4-3.1 as long as B<sub>1</sub> ; cephalic B<sub>1</sub> longer, 1.5-1.8 as long as B<sub>2</sub> ; on *Castanopsis* ..... *pasaniae*
- B<sub>3</sub> on T<sub>6</sub> and T<sub>7</sub> (Fig. 10.3) shorter, expanded apically ; B<sub>3</sub> on T<sub>7</sub> 1.5-1.7 as long as B<sub>1</sub> ; cephalic B<sub>1</sub> shorter, 1.2-1.3 as long as B<sub>2</sub> ..... 3
- 3. Head with B<sub>3</sub> ; pronotal B<sub>1</sub> more than 2.0 as long as B<sub>2</sub> ; mesonotal DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 0.9-1.1 ; on *Engelhardtia* ..... *pinanganus*
- Head (Fig. 10.1) without B<sub>3</sub> ; pronotal B<sub>1</sub> less than 2.0 as long as B<sub>2</sub> ; mesonotal DB<sub>1</sub>-B<sub>1</sub>/DB<sub>1</sub>-B<sub>2</sub> 1.5-2.0 ; on *Quercus* ..... *roberti*
- 4. B<sub>1</sub>, B<sub>2</sub> and B<sub>4</sub> on T<sub>9</sub> (Fig. 7.3) blunt apically ; A<sub>7</sub> 4.8-5.7 as long as wide ; pronotal B<sub>1</sub> 3.0-4.0 as long as B<sub>2</sub> ; pronotal B<sub>7</sub> pointed, shorter than B<sub>1</sub> ; B<sub>3</sub> on T<sub>7</sub> 2.5-2.9 as long as B<sub>1</sub> ..... *medangteja*
- B<sub>1</sub>, B<sub>2</sub> and B<sub>4</sub> on T<sub>9</sub> (Fig. 8.3) pointed apically ; A<sub>7</sub> 3.1-3.9 as long as wide ; pronotal B<sub>1</sub> 1.0-1.7 as long as B<sub>2</sub> ; pronotal B<sub>7</sub> blunt, at least as long as B<sub>1</sub> ; B<sub>3</sub> on T<sub>7</sub> 1.8-2.1 as long as B<sub>1</sub> ..... *rotundus*

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